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Mountain Ungulates

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Envis Bulletin

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Mountain Ungulates

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Director's Note

The Wildlife Institute of India (WII) has been contributing substantially in the field of 'high altitude ecology' and in the conservation of mountain flora and fauna through research and training activities since 1986. WII's faculty and researchers have carried out several surveys for endangered species, ecological studies on endangered species/faunal groups and their habitats, and has conducted training programmes related to research, monitoring and management of these species and habitats in the Himalaya. During the last 16 years, significant efforts have been made for the conservation of mountain ungulates of the Himalaya by researchers and managers from different institutions and organisations in collecting ecological information for planning better conservation strategies. Some of the recent initiatives by WII in the field of mountain ungulate research and conservation include the 'Collaborative Ladakh Field Research Programme' jointly carried out by WII, United States Fish & Wildlife Service, International Snow Leopard Trust; Snow Leopard Conservancy and the 'Institutional Co-operation Programme between WII and University of Tromsø, Norway, on Pastoralism and Wildlife Conservation in the Himalaya'.

In order to increase global awareness of the importance of mountains, the United Nations had declared the year 2002 as the 'International Year of the Mountains' (IYM) and to commemorate the IYM – 2002, we decided to bring out this issue which covers different aspects of the ecology and conservation of 15 mountain ungulate species that occur in the Himalayan and Trans-Himalayan regions of India. The different aspects include the species accounts, protected areas coverage, mountain ungulate conservation, conservation issues, veterans' section and a bibliography. The Himalayan range states have contributed information on the status of the mountain ungulates. I hope this issue will be appreciated by all users and we welcome your feedback on the same.

Our next issue of ENVIS will be on "Conservation of Tropical Rain Forests of India".

S.Singsit
Director, WII & Team Leader
ENVIS Centre, Wildlife Institute of India

Foreword

The Indian Subcontinent has the greatest mountain systems of the world - the Himalaya, which is well recognized for its rich and diverse biodiversity, and for its significance in providing the life support systems for several million people in the northern region. The Himalaya has many magnificent mountain ungulates that are widely known for their diversity and splendour. The beautiful Hangul, the majestic Argali, the agile Ibex, the sure-footed Tahr, the bounding Musk Deer, the mighty Yak, the elegant Kiang, and the elusive Serow are just some of the mountain ungulates that occur in the Himalaya. Mountain ungulates have always been admired by explorers, adventurers, naturalists, hunters and the common man for their beauty, sure-footedness, and their ability to survive in steep and rugged terrain under harsh climatic conditions.

Mountain ungulates have remained least studied as their habitats are in the remote high altitudes of the Himalaya where conditions are inhospitable. Despite these limitations, some of the best natural history observations have been made on mountain ungulates by the early explorers, hunters and naturalists. Hunting was probably the only activity that could have had some effect on mountain ungulate populations in the Indian subcontinent in the pre-independence period. The rapid human and livestock population growth in the Himalaya in the last five decades have led to habitat loss, habitat degradation, poaching, trade, wildlife-human conflicts and consequently have seriously threatened several mountain ungulate species and their habitats in the Indian subcontinent.

Conservation of these mountain ungulates is crucial as they form the prey base of the elusive snow leopard and other large carnivores, and some of them are of international importance. Undoubtedly, protection to these mountain ungulates and their habitats is of prime concern and also the need for efficient wildlife management based on scientific information. During the last two decades, attempts have been made to conserve and manage mountain ungulates in the Indian subcontinent. Creation and management of Protected Areas was one significant step. Some scientific studies and several status surveys and short studies have been carried out on mountain ungulates in the Indian subcontinent that have added substantial knowledge to our understanding of the species ecology and conservation issues.

Proper dissemination of information is as important as the collection itself. This ENVIS issue on Mountain Ungulates of the Indian Subcontinent brought out by the Wildlife Institute of India is a good combination of updated information on mountain ungulate species, their status and distribution in different states of India, conservation and management issues, natural history by veterans, and bibliography. This publication will be of great value to biologists, wildlife managers and others.

J.C.Daniel
Honorary Secretary,
Bombay Natural History Society

The Mountain Ungulates of the Greater and Trans - Himalaya: An Introduction

- Editors

Mountains are widely acknowledged as the 'water towers' of the world in addition to being rich repositories of, often, unique biodiversity. Recognizing these values of the mountains, the UN had declared the year 2002 as the 'International Year of the Mountains' to generate awareness about the conservation and sustainable development of the mountains.

The Himalaya are the most prominent mountains in India and the region covers *ca.* 12% of the country's 3.3 million km^2 geographical area. The present issue is dedicated to a fascinating, yet little known part of its fauna – the mountain ungulates inhabiting the cold, rugged mountains of the higher Himalaya – the *ridaks* or the Mountain Monarchs, as some mountain people call them.

In this chapter, we give a brief overview of the Himalayan region, its wildlife values and the reasons for choosing the present theme for the Bulletin.

The Himalaya and Associated Mountains

The Himalaya are the youngest of world's mountain chains and have among the highest peaks in the world. These mountains form the watershed for most of the rivers flowing in northern India, which sustain millions of humans who inhabit the Indo-Gangetic plains. The high ranges of the Himalaya stop the northward flow of the monsoon clouds and thus responsible for the climate and prosperity of the people living in the northern region of the Indian subcontinent.

The Himalaya trace an arc of over 2,500km, from the Nanga Parbat in the west, to the Namche Barwa in the east in a roughly NW-SE orientation. In Jammu & Kashmir, the mountains and valleys of the Pamirs and the Hindu Kush spread further west, the Karakorum, east and the Kunlun mountains towards the NE, this forming one of the most formidable mountain complexes of the world. Further north, the Altai and Tien Shan ranges lead into the heart of Cenral Asia. There are a range of low mountains further that emerge from the western fringes in Pakistan, and align in a NE-SW orientation towards the deserts of Baluchistan as the Salt and the Kirthar ranges. In the east, the mountains take a sharp southward turn from Namche Barwa into the mountains of Myanmar and Bangladesh, moving further into south east Asia. The Himalaya, are thus a part of the largest mountain complex of the world and bridges its major realms, the oriental in the east and south, the Palarctic along the north and the Ethiopian along the west.

The vast spread of the Himalaya has a width varying from 200km in parts to over 500km in others. This expanse has a great variation in topography as well as biodiversity along the south to north, and the east to west axis. Humidity in general declines from east to west and from south to north, along the Himalaya.

The foothills, or the Siwalik mountains are uplifted glacial debris, at places extending to *ca.* 1,000m above mean sea level. Higher on are the 'Middle Himalaya' extending up to *ca.* 3,000m as undulating hills, at places cut steeply by flowing torrents and rivers. Beyond the Middle Himalaya, is the towering Greater Himalayan range consisting primarily of igneous formations with patches of sedimentary rocks. Bulk of this area is covered with huge glaciers and peaks, with relatively arid, cold valleys in their fold. Across this great barrier, is the vast arid expanse of the Tibetan Marginal Mountains and the Tibetan Plateau, often referred to as the Trans-Himalaya. The Trans Himalaya are categorized as the Zone 1 (with two provinces) as per the biogeographically classification by Rodgers & Panwar (1988) and roughly covers 5.6% of the country's geographical area. The rest of the

Himalaya are categorized as the Zone 2 (with four provinces) and covers roughly 6.4% of the country.

More interesting facts about the Himalaya such as the orogeny of the Himalaya, ecological zonation, and flora and fauna can be found in Schaller (1977) and Polunin & Stainton (1992), apart from numerous other publications.

The Mountain Ungulates of the Himalaya and Trans-Himalaya

The ungulate fauna of the Himalaya include species such as the chital, sambar, wild pig, Asian elephant, species that are found in other parts of the country too. There are however various cervids, moschids, bovids and equuids unique to the Himalaya or limited to the high mountain chains of Central Asia. Most of these species evolved to inhabit the niches produced by spectacular mountain building during the Cretaceous and Tertiary that created new, usually cold and bleak landscapes, and are well adapted to these harsh environments. This little known fauna comprising of 15 species/subspecies have been selected for the present ENVIS Bulletin (Table 1). The taxonomy of this group of animals is greatly debated and we have mostly limited our listing to classification by Schaller (1977), Schaller (1998) or Shackleton (1997). We have not included the Wild Goat (*Capra aegagrus*) and the *Shou* or Sikkim stag (*Cervus elaphus wallichi*), since its occurrence in the country are not confirmed.

It is noteworthy that this assemblage of species/ subspecies constitutes *ca.* 50% of India's ungulate fauna. Many of these species are wild relatives of sheep, goat, horse/donkey and yak, thus adding value to this assemblage as an important genetic pool.

The ungulates of the high mountains are prey to charismatic predators such as the snow leopard, Tibetan wolf and common leopard. An understanding of their ecology can thus help in better management of the entire region.

Most of WII's ENVIS Bulletins so far have been taxa based (elephants, small cats, crocodilians, non-human primates) or on the PA network in the country. The issues on taxa usually provide exhaustive articles from experts with either a species or a regional focus. As alluded to earlier, in this volume we have confined ourselves to the Himalayan region among all the mountain chains in the country due to its unique value as the highest, significant ecological entity, grand and fragile, yet harbouring some of the most pristine habitats for wildlife left in the country. Within the Himalaya, we have chosen accounts on those ungulate species that are either unique to the Himalaya or are confined to the mountain ranges alone.

Layout of the Issue

The issue is divided into five Sections in order to cover various facets of mountain ungulates and their conservation. Section One gives species accounts of the fifteen species/subspecies present in the country. The two chapters in this section give brief accounts of the species in the Himalayan and the Trans-Himalayan regions in a 'field guide' format. This, we believe, should be useful for the lay user as well as the serious reader to easily acquaint with the species, its distribution, status, habitat, behavioural traits, morphology and key biological facts. We have tried to give clear photographs of all species, but where not available, we have given sketches.

There is a wealth of information available with the State Forest/Wildlife Departments on animal distribution and status, their vision for wildlife conservation, and management actions being taken. Often, these efforts are little known and appreciated. The Section Two on ' Protected Area Network and State Reports on Status and Management of Mountain Ungulates' is meant to bridge this gap to some extent. The Himalaya are spread over six Indian states. We were able to receive articles from five of them which are presented in this section.

The fragile Himalayan region is faced with numerous conservation issues. Some of them such as livestock grazing in Protected Areas and human-wildlife conflicts are common with the rest of the country, but there are unique socio-economic peculiarities that make dealing with

them more challenging. These issues and possible solutions for them are detailed for the Himalayan and the Trans-Himalayan regions in Section Three of this Bulletin.

The Himalaya have fascinated naturalists since time immemorial. A few decades ago however some scientists and naturalists have painstakingly documented the region's wildlife, often under very harsh conditions and with few facilities. We have tried to bring this perspective on what was their driving force, their trials and tribulations in initiating these studies, in Section Four – 'Semi-Scientific Accounts by Veterans on Research and Conservation Experiences on Mountain Ungulates'.

Although there have been few quantitative studies and assessments on the mountain ungulates in the Himalaya, there is a wealth of information as anecdotal accounts that reveal a lot about the species. We have developed and included an exhaustive bibliography on the useful references for mountain ungulates and about conservation of the region in general as the last section of this volume.

The Wildlife Institute of India has pioneered research on wildlife in the Himalayan region since its inception, the very first research project being an extensive survey on the snow leopard and its prey species in the Western Himalaya. Through the twenty years of its existence, WII researchers and scientists have worked hard under daunting conditions to conduct over 30 critical studies and 20 surveys documenting the varied facets of the region's biodiversity and conservation issues. Through this Bulletin we wish to add an important and useful compilation on the conservation of the magnificent mountains crowning the country.

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Table 1: Mountain ungulate species covered in this volume along with information on the primary region where they occur.

S. No	Species	Scientific name	Primary region
	Order - Artiodactyla		
	Family – Bovidae		
	Subfamily – Caprinae		
	Tribe - Rupicaprini		
1	Grey Goral (also Red Goral)	*Nemorhaedus goral goral (Nemorhaedus baileyi)*	H
2	Mainland Serow	*Nemorhaedus sumatraensis*	H
	Tribe - Ovibovini		
3	Mishmi Takin	*Budorcas taxicolor taxicolor*	H
	Tribe - Caprini		
4	Himalayan tahr	*Hemitragus jemlahicus*	H
5	Himalayan Ibex	*Capra sibirica*	TH
6	Flare horned (Kashmir) Markhor	*Capra falconeri falconeri*	TH/H
7	Blue sheep or Bharal	*Pseudois nayaur*	TH/H
8	Ladakh Urial	*Ovis vignei vignei*	TH
9	Tibetan Argali	*Ovis ammon hodgsoni*	TH
	Tribe - Saigini		
10	Chiru/Tibetan antelope	*Pantholops hodgsoni*	TH
	Tribe - Bovini		
11	Wild Yak	*Bos grunniens*	TH
	Subfamily - Antilopinae		
	Tribe - Antilopini		
12	Tibetan Gazelle	*Procapra picticaudata*	TH
	Family - Mochidae		
13	Himalayan Musk Deer	*Moschus chrysogaster*	H
	Family - Cervidae		
14	Hangul or Kashmir Stag (also *Shou* or Sikkim Stag)	*Cervus elephas hanglu* (*C. e. wallichi*)	H
	Order - Perissodactyla		
	Family - Equuidae		
15	Tibetan wild ass	*Equus kiang*	TH

Himalaya (H) or Trans Himalaya (TH))

Chapter 1

Species of the Greater Himalaya

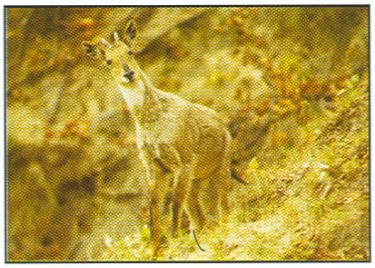
S.Sathyakumar

GORAL *Nemorhaedus goral* Hardwicke 1825

Vernacular/other Names: *ghooral, rome* Kashmiri), *ra giyu* (Sikkim Bhotia)

Taxonomy
Family: Bovidae
Sub Family: Caprinae
Tribe: Rupicaprini

Conservation Status
IUCN: Low Risk
CAMP: Not evaluated
IWPA: Schedule I
CITES: Appendix-I
U.S. ESA: Endangered



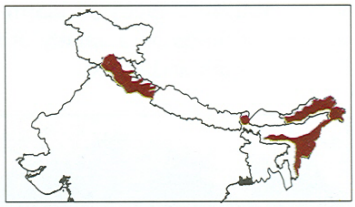
A.J.T. Johnsingh

Distribution & Habitat: Two subspecies of goral occur in India, *viz.*, the **Grey goral** (*N.g.goral)* distributed in the Western Himalaya (upto 3,300m) and Shiwaliks in the states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal and Haryana; and the **Brown goral** (*N.g.hodgsni*) in the Eastern Himalayas and the hills of N.E. India in the states of Sikkim, northern West Bengal, Arunachal Pradesh, Nagaland, Meghalaya and Mizoram. Another species, the **Red goral** (*Nemorhaedus baileyi*) is reported to occur in a small region in Arunachal Pradesh at the junction of Tibet, Yunnan and Myanmar. Inhabits sparsely wooded slopes with open grassy patches in a wide range of habitats that includes alpine meadows, subalpine forests, temperate forests, subtropical pine forests, tropical moist deciduous forests of Shiwaliks, and montane wet temperate and evergreen forests in N.E. India.

Description: A monomorphic mountain goat as body size, horn size and colouration are same in both sexes. However, adult males could be distinguished from females based on the body size and horn size, if observed at close quarters. The general body colour of **Grey goral** is yellowish grey suffused with black and the hair on the pale area is not tinged with rufous or brown. The chin, upper lip, undersides of jaws and throat patch are white. The dark spinal stripe, if present, does not pass beyond the withers. There is no stripe down the middle of the tail and none up the back of the thighs. The body colour of **Brown goral** is golden or rufous brown specked with black. The black spinal stripe reaches to the root of the tail. A dark ill-defined stripe runds up the back of the thighs from the hocks. Both males and females have short insignificant sharp horns black in colour which diverge slightly, curve backwards, marked with rings or ridges.

Size
Body length: 106-117
Weight: 25-30 kg
Horn length: 13 cm

Behaviour: A cliff-dwelling mountain goat occurs singly or in pairs or in small parties of 3-5 individuals. Aggregations of >5 individuals (largest reported 13 individuals) may occur during feeding depending upon the food resource availability and distribution. Predators are the Common leopard and the Himalayan yellow-throated Marten. When approached by a predator or human, goral makes an alarm call "Hiss" runs for escape cover or escape terrain, and may stop to look back. Actively feeds during early mornings and late afternoons resting under cover during noon. Goral are primarily grazers, although they feed upon tender shoots of certain shrubs and leaves of trees when available.



S. Sathyakumar

Reproduction & Life cycle
Gestation period: 6 months
Rutting: late autumn-early winter
Young per birth: one
Weaning: not known
Sexual Maturity: 3 years
Life Span: 10-12 years; 17 years 7 months in captivity

MAINLAND SEROW *Nemorhaedus sumatraensis* Bechstein 1799

Vernacular/other Names: *sarao*, *thar* (nepali), *ramu* (Kashmiri), *gya* (Sikkim)

Taxonomy

Family: Bovidae
Sub Family: Caprinae
Tribe: Rupicaprini

Conservation Status

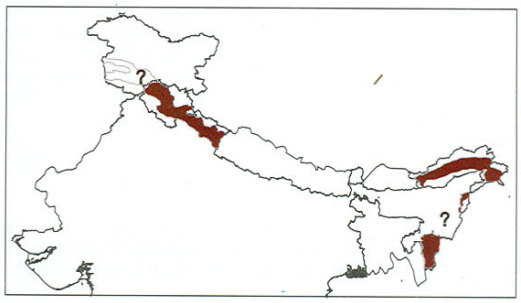
IUCN: Vulnerable
CAMP: Not evaluated
IWPA: Schedule I
CITES: Appendix-I
U.S. ESA: Endangered

S. Sathyakumar

Distribution & Habitat: In the southern side of the Greater Himalaya (2,000 - 3,300m); and in the hills of N.E. India (>200 m). Occurs in the states of Himachal Pradesh, Uttaranchal, Sikkim, Arunachal Pradesh, Mizoram and Manipur. Temperate and subalpine forests in the Greater Himalaya and montane wet temperate and evergreen forests of N.E. India. Two subspecies of serow are reported to occur in India, the **Black Serow** (*N.s.edwardsi)* distributed in the western and eastern Himalaya and the **Red Serow** (*N.s.rubidus)* distributed in eastern Himalaya.

Size
Body length: 140-180 cm
Shoulder Height: 100-110
Weight: 90 kg
Horn length: 15.2-25.5 cm

Description: An elusive mountain goat, with a large head, donkey-like ears, thick neck and short legs. The coat is coarse and rather thin; it colour varies from grizzled black or blackish grey-roan to red. In the darker males, the head, neck, and the mane that covers the nape and withers are grizzled black. The black passes into rusty red on the shoulders, flanks and lower thighs, and turns a dirty grey on the inside of the limbs and belly. The muzzle, throat and chest have varying amounts of white. Both sexes have horns which are black, conical and closely wrinkled for three quarters of their length



Behaviour: A solitary and shy mountain goat inhabiting steep, rugged, inaccessible densely forested habitats that includes thickly wooded-gorges with boulder-strewn slopes and shallow caves or overhangs. Although solitary in nature, serow is also found in pairs and in groups of three or four. Serow is a territorial species and appears to be nocturnal or crepuscular. Predators are the Common leopard and possibly Red fox and Himalayan yellow-throated Marten on the young. When disturbed, gives an alarm call that is a loud whistle. It feeds on a variety of food items including oak leaves, shrubs, grasses, montane bamboo, ferns, mosses and lichen.

S. Sathyakumar

Reproduction & Life cycle

Gestation period: 6 months
Rutting: late autumn
Young per birth: one
Weaning: 6 months
Sexual Maturity: 2.5 years (F) 3 years (M)
Life Span: 10-12 years

TAKIN *Budorcas taxicolor Hodgson 1850*

Vernacular/other Names : Not known

Taxonomy

Family: Bovidae
Sub Family: Caprinae

Conservation Status

IUCN: Endangered
CAMP: Not evaluated
IWPA: Schedule I
CITES: Appendix -II
U.S. ESA: Not listed

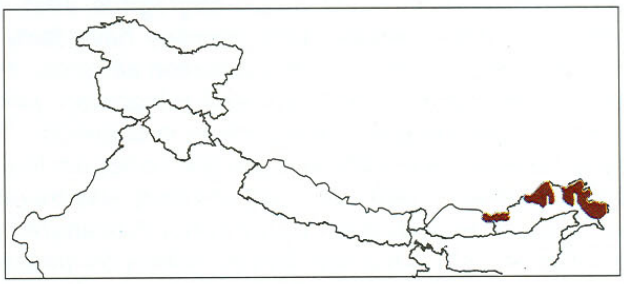
G.S. Rawat

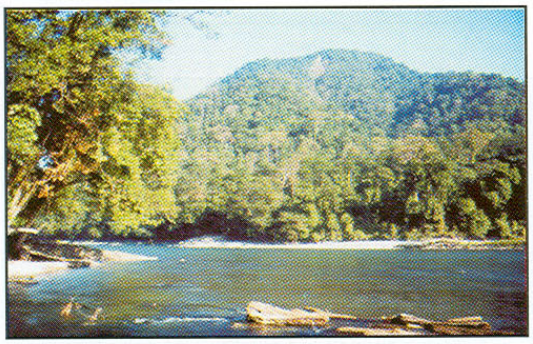
Distribution & Habitat: Arunachal Pradesh. Tropical forests (900-1,200m), dense bamboo and rhododendron forests (2,000-3,000m). Recently reported from Kyongnosla Alpine and Pangolkha Wildlife Sanctuaries in Sikkim.

Description: A clumsy heavy animal, having a convex face, heavy mouth, and tremendously thick neck. The muzzle, except for a base spot at the extremity is covered with hair. Withers are slightly raised and its narrow back arches in the center and slope downwards to the root of the tail. Body colour ranges from dark brown to golden yellow. Withers are conspicuously lighter in tone. Adult males are golden yellow merging into dark brown or black on the flanks and quarters. There is a dark dorsal stripe. Young males are reddish brown in front merging into black. Calves all black. Females are grayer than males with no yellow. The dark dorsal stripe is inconspicuous in females and young males. Horns of young Takin grow straight up from the head with an outward tendency. Later they grow outwards and then downwards. In final stages, the horns grow forward and bend downwards and outwards with the points growing up.

Size
Body length: 170-237 cm
Shoulder Height: 110 cm
Weight: 300 kg
Horn Length: 63.5 cm

Behaviour: Inhabits the steepest and most thickly wooded habitats in the mountains. In summer, found in large herds of even up to 300 individuals, and break up into small parties in winter. Generally active during early morning and late afternoon, while resting in cover during mid day.





G.S. Rawat

Reproduction & Life cycle
Gestation period: 8 months
Rutting: July-August
Young per birth: one
Weaning: ?
Sexual Maturity: 2.5 years
Life Span: 15-20 years; 19 years & 7 months in captivity

HIMALAYAN TAHR *Hemitragus jemlahicus* H.Smith 1826

Vernacular/other Names: *jungli bakri* (Hindi), *thar, karth (male), tanne, bakri (female) jharal, jharal-thar*, (local names) *kras, jagla* (Kashmiri) *yang, reiwo* (nepali)

Taxonomy

Family: *Bovidae*
Subfamily: Caprinae

Conservation Status
IUCN: Vulnerable
CAMP: Low Risk
IWPA: Schedule I
CITES: Not listed
U.S. ESA: Not listed

D. Forsyth

Distribution & Habitat:

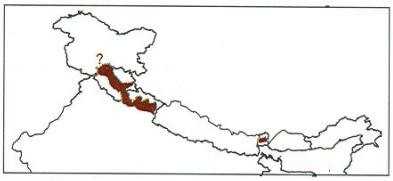
Inhabits a narrow strip along the southern side of the Greater Himalaya between 2,000 and 4,400m in the states of Jammu & Kashmir, Himachal Pradesh, Uttaranchal & Sikkim. Temperate and Subalpine forests interspersed with open steep slopes, temperate and subalpine scattered tree and scrub habitats, alpine scrub and meadow habitats.

Description:

A mountain goat with finely formed head, narrow erect ears, a heavy body, and long robust limbs. The body is covered with tangled masses of coarse, flowing hair, particularly well developed in adult males and forms a prominent ruff and mane that may attain a length of 25 to 30 cm, up to the knees in males. They also have a long mantle of hair that drapes from the side and rump. The fur is deep reddish brown, and there is dark mid dorsal streak, not always distinct. Old males are darker, particularly on the back and quarters. Females and young males are lighter brown and the kids much paler. Both male and female have massive horns almost of equal size. The horns are close-set, stout at the base, keeled in front and wrinkled except towards the tips. They curve backwards, and in old males continue downwards.

Behaviour: Group-living mountain goat that inhabits the most inaccessible terrain characterized by open steep slopes, scattered trees, scrub and grassy blanks, cliffs and rocks. Tahr live in mixed herds (1-77) for most of the year excepting for a brief period in spring when many adult males segregrate after rut to higher altitudes. Adult females and juveniles have fairly fixed home ranges and move considerably between altitudes. Predators are snow and common leopards and Himalayan yellow-throated marten. Poaching for meat by man is common. They seldom stray far away from cliffs and precipitous terrain that serves as escape terrain. Tahr are good climbers and traverse ledges and rock faces with great agility to reach scattered patches of vegetation. Tahr is a grazer feeding mainly on grasses, sedges, herbs, ferns and mosses. Prefers to feed actively during early mornings and late afternoons, and resting during mid day.

Size
Body length: 130-170 cm
Shoulder Height: 90-100 cm (M)
84-89 cm (F)
Weight: 90 kg (M) 60 kg (F)
Horn length: 41.9 cm record (M)
Not more than 25 cm (F)



S. Sathyakumar

Reproduction & Life cycle

Gestation period: 6.5 months
Rutting: late autumn-early winter
Young per birth: one
Weaning: 2-3 months
Sexual Maturity: 2-3 years
Life Span: 12 to 15 years, 21 years 9 months in captivity

HIMALAYAN MUSK DEER *Moschus chrysogaster* Hodgson 1839

Vernacular/other Names: *kasturi mrig*, *kastura*, *bina*, (local Names), *roos* (kashmiri)

S. Sathyakumar

Taxonomy

Family: *Moschidae*

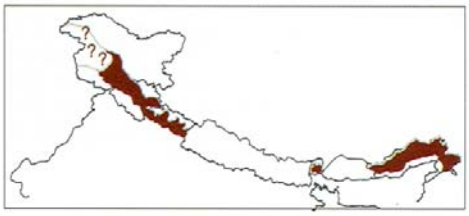
Conservation Status
IUCN: Vulnerable
CAMP: Critical
IWPA: Schedule I
CITES: Appendix - I
U.S. ESA: Endangered

Distribution & Habitat: All along the southern side of the Greater Himalaya between 2,500m to 'treeline' in Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Sikkim & Arunachal Pradesh. Upper Temperate, Subalpine forests, alpine scrub and meadow habitats. Two sub species of Himalayan musk deer occur in India, *M.c.chrysogaster* distributed in western Himalaya and *M.c.leucogaster* distributed in eastern Himalaya. Two other species, the Black Musk deer *M.fuscus* and the Dwarf Musk deer *M.berevoskii* are also reported to occur in some parts of Arunachal Pradesh that are close to China and Myanmar borders, but needs confirmation.

Description: Not a true deer, but a primitive deer-like ruminant. Differs from other deer by not having antlers and facial glands. Has gall bladder, caudal gland and musk gland which no other deer possess. Canines are greatly developed especially in males. Stockily built animal with small head having hare-like long ears, arched back and bounding gait. Hind legs are 5 cm longer than the forelegs. Well-developed dew claws or lateral hooves. The general body colour is grey-brown to light-brownish yellow or dark yellow or dark brown with two white throat stripes. The colour of the ear tips range from dark brown to ivory-yellow or white. Rump and thigh are darker and the belly pale brown. Genital regions are white and the tail is naked except for a tuft of hair at the tip. Fur coat is thick and wavy giving it a deceptively heavy built appearance.

Behaviour : Musk deer is a Small Solitary Forest Ruminant (SSFR) that inhabits the upper temperate, subalpine and alpine habitats between 2,500 m and 'treeline'. It is a sedentary animal and is either nocturnal or crepuscular spending most of the day under dense undergrowth and come out of cover for feeding in open alpine grasslands during night but seldom stray far away from escape cover. Wild predators of musk deer include snow and common leopards, Himalayan yellow-throated marten, and possibly Red fox. It makes a non-vocal alarm call "Hiss" and stot on sensing danger. Man has persecuted this species for centuries for its musk. Being a SSFR, musk deer rely largely on communication by olfaction which is by means of scent marking behaviour and that includes defecating at defecation sites and by pasting with the secretions of the caudal gland by both sexes, and in case of males by the secretion of musk in urine. Musk deer has high-energy requirement per unit of body weight and it must select high quality food. It is called a "nibbler" rather than browser as it selectively feed on young leaves, buds, fruits, flowers of dicots, mosses and lichen.

Size
Body length: 70-100 cm
Shoulder Height: 50 cm
Weight: 13-15 kg
Canine length: 10.5 cm record



S. Sathyakumar

Reproduction & Life cycle

Gestation period: 180-200 days
Rutting: winter
Young per birth: one, twinning is also common
Weaning: six weeks
Sexual Maturity: 1.5 years
Life Span: 8-10 years, 15 years in captivity

KASHMIR STAG *Cervus elaphus hanglu* Linnaeus 1758

Vernacular/other Names: *hangul, honglu* (Hindi/Kashmiri)

C.E.E.

Taxonomy

Family: *Cervidae*
Subfamily: Cervinae

Conservation Status
IUCN:Endangered
CAMP: -
IWPA: Schedule I
CITES: Appendix - I
U.S. ESA: Endangered

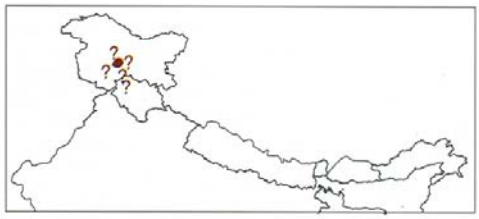
Distribution & Habitat: At present occurs only in the Dachigam National Park and a few isolated pockets in Jammu & Kashmir State of India. In the past, it was distributed in mountains of Kashmir and in Chamba District of Himachal Pradesh. Subalpine forests, temperate broad leaved oak and conifer mixed forests, riverine forests, grasslands and scrub habitats

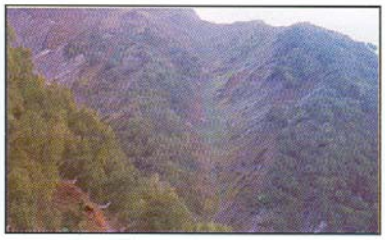
Description: A subspecies of the Red deer of Europe that is distinctly different from the Red deer in body size, colour, and antler size and shape. Hangul is dark grey and dark brown rather than reddish and unlike Red deer, the antler bay tine is normally larger than brow and has much of cup. In Hangul, 10 - point head is the normal one and any greater number of points is far more usual than in the case of Red deer. The coat colour ranges from light to dark brown, fading to dingy white on lips, chin, underparts and anal region. The white rump patch does not extend much above the tail and is divided by a broad median stripe extending down to the base of the tail and sometimes to its extremity. Coat colour fades during summer, but tones up with denser coat in winter, which in big males is very dark or rufous brown. Fawns are spotted. Old females may show white flecks. Antlers in adult males grow up to 1 m

Behaviour: Hangul is essential a forest animal found singly or in groups of about 10 -15 individuals. It is diurnal and make distinct altitudinal migration from higher to lower elevations in winter. Predators are snow and common leopards. It is a selective feeder and feeds on a wide variety of plants that includes leaves/shoots of some trees and shrubs, grasses and herbs.

Size
Body length: 165-265 cm
Shoulder Height: 120-125 cm
Weight: 180 kg
Antler length: 1 m

Another subspecies of the Red Deer that is reported in the Indian subcontinent is ***Shou*** or **Sikkim stag** (*Cervus elaphus wallichi*). It is reported to occur in Chumbi valley located close to the Indo-China border in Sikkim and there are unconfirmed reports of this subspecies being sighted occassionally in Pangolokha Wildlife Sanctuary.





K. Ahmed

Reproduction & Life cycle

Gestation period: six months
Rutting: late autumn-early winter
Young per birth: one
Weaning: 7 months
Sexual Maturity: 2.5 years (f) 2 years (m)
Life Span: 12-15 years

Chapter 2

Species of the Trans-Himalaya and other Arid Tracts

SIBERIAN IBEX, *Capra sibirica, Pallas 1776*

Y.V. Bhatnagar

Vernacular Names: *Kin* (Spiti), *Skin* (Ladakh), *Tangrol* (Kullu, Lahul)

Taxonomy

Family: Bovidae
Sub family: Caprinae
Tribe: Caprini

Conservation Status

IUCN: Low risk
CAMP: Vulnerable
IWPA: Schedule I
CITES: Not listed
US ESA: Not listed

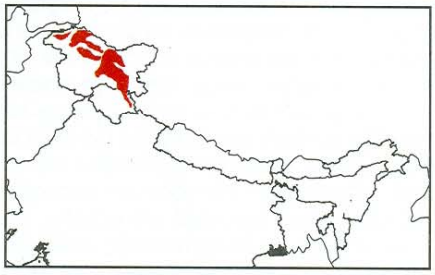
Y.V. Bhatnagar

Distribution & Habitat : Rocky alpine steppe and the rugged tracts of the Central Asian mountains - from the Hindu Kush in Afganistan till the Sutluj gorge in Himachal Pradesh, India; and northwards along the Altai Shan and Tien Shan, into Mongolia and Russia. Within India in western Ladakh (Zanskar and Ladakh ranges) and Nubra in Jammu & Kashmir, and Lahul-Spiti in Himachal Pradesh. Covers *ca.* 25,000km^2 within these two states.

Description: Stocky built goat. Largest in the genus. The general colour of the pelage is a light tan, with the undersides lighter; the coat colouration however, varies widely across this ibex's range. In the Himalayan population during winter, mature males are much darker (dark chocolate brown; especially males older than 5 years), with patches of white on the neck and back. Dark dorsal stripe from lower neck till the tail pronounced in males. The lighter ventral parts of females and young males are separated from the main body colour by a darker band which runs along the sides. Both sexes have a dark beard beneath the chin, although it is much less pronounced in females. Both sexes carry horns - in males they grow into massive arcs, which curl over the back and may even loop back on themselves, while in females they are small, almost parallel and slightly arched towards the rear. A male's horns have several large knobs on their frontal surface. Till the 7th-8th year two knobs are added each year; after which it is usually one every year.

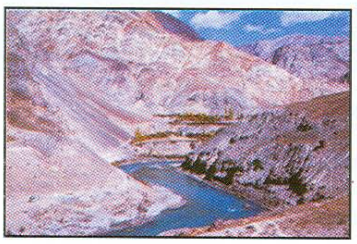
Size
Body Length: 130-165 cm
Shoulder Height: 67-110 cm
Weight: Male 85-130kg ; Female 40-60kg
Horn length: Male: 100-148cm, Female 15-30cm

Behaviour: The Siberian ibex live at high elevations, and often climb up to the vegetation line at 5,500m. In India, they usually occur between 2,500 and 5,500m. In many areas, they do not descend to lower elevations during winter. Uses primarily steep slopes, interspersed with 'escape terrain' in the form of rocky overhangs and cliffs, where they flee to escape predators such as snow leopard and the Tibetan wolf. In winter, partial to south facing slopes and areas where snow deposition is relatively lower such as windblown ridgelines, crests and avalanche paths. When snow cover is heavy, Siberian ibex find food by pawing at the snow with their forelegs in order to reach the vegetation concealed below. Most hierarchy is established before the onset of the rut based on body and horn size, but when contests do take place they may extend for over three hours of clashes, body and shoulder pushing and horn entwining. During the clashes, a male would typically go upslope, rear on its hind limbs and clash down at the lowered horns of the opponent, often trying to dislodge it.



Occur in small groups - mean around 11 animals per group; occasional congregations of 70-100 animals may occur in spring. Principally a diurnal animal, the Siberian ibex has alternating periods of resting and activity throughout the day. Usually forage in early forenoon and late afternoon, but have a distinctly unimodal foraging peak during the noontime in peak winters. Adult males primarily separate into 'all-male groups' during the summer.

Is an intermediate forager, feeding primarily on grasses, forbs, leaves and shoots of shrubs and also trees.



Y.V. Bhatnagar

Reproduction & Life Cycle
Gestation Period 180 - 180 days
Rutting: Peaks for about 15 days in Nov to Jan (varies between years and regions)
Young per Birth: 1; twins not uncommon in well-protected areas
Weaning: Gradual, without a sharp cutoff-usually 6-7 months.
Sexual Maturity: At 1.5-2 years, although males do not reach their full potential before age 5-7
Life span: Up to 16 years in captivity. Males rarely survive beyond their 7-8 year

FLARE HORNED OR KASHMIR MARKHOR, *Capra falconeri, Wagner 1839*

Vernacular Names: *markhor* (Punjab and Kashmir), *raphoche* (male) *rawache* (female)

C.E.E.

Taxonomy

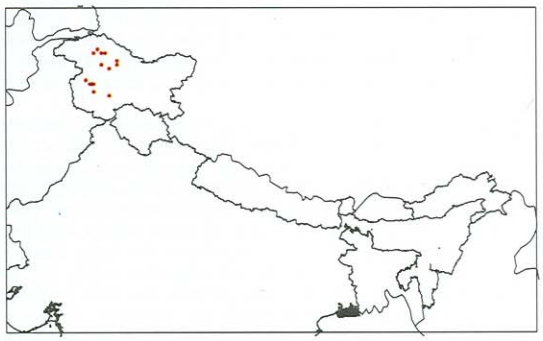
Family: Bovidae
Sub family: Caprinae
Tribe: Caprini

Conservation Status
IUCN: Endangered
CAMP:Critical
IWPA: Schedule I
CITES: Appendix I
US ESA: Endangered

Distribution & Habitat : Sparsely wooded mountainous regions in the western Himalayan Pir Panjal range at an elevation of 600-3,600 m. In India, they occur only in a few pockets of the Kashmir valley, notably the Kisthwar National Park, in the Greater Himalaya, with possibilities of their occurrence in the Pangi valley of Himachal Pradesh too. Bulk of the distribution is however in the Trans-Himalayan areas, now in the PoK. Other subspecies of markhor occur in the Salt, Safed Koh, Hindu Kush and Kirthar ranges in Pakistan, in eastern Afghanistan and southern Tajikistan.

Size
Body Length: 132-186cm
Shoulder Height: 102cm (65-115cm)
Weight: 104 kg; Male 100-110kg ; Female 32-50kg
Horn length: Male: 143cm, Female 25-30cm

Description : The grizzled light brown to black coat is smooth and short in summer, growing longer and thicker in winter. Males have long hair on the chin, throat, chest, and shanks, while females have smaller fringes. The lower legs have a black and white pattern. Males have loosely curled, corkscrew-like horns, starting close together at the head, but spreading towards the tips. In males, they can grow up to 160 cm, and up to 25 cm in females. Female horns are also slightly twisted. A dark lateral stripe is present in males and is usually fainter in females.



Behaviour : Occurs in low to mid elevation, open and slightly wooded arid tracts in the Trans-Himalaya and parts of the Greater Himalaya. May migrate up to 4,000m in summer, but essentially remain in areas where rugged valleys and mountains are available at *ca.* 2,200m. Distinctly avoid areas with high snow cover. Lack underwool and thus avoid excessively cold areas, but can tolerate high temperatures reaching up to 45°C. The markhor's alarm call resembles the nasal "a" not very different from the common domestic goat. The primary natural predators are leopard, Tibetan wolf, snow leopard, and lynx. Markhor, a wild goat species, are efficient negotiators of steep cliffs and use this to escape predators

Reproduction & Life Cycle

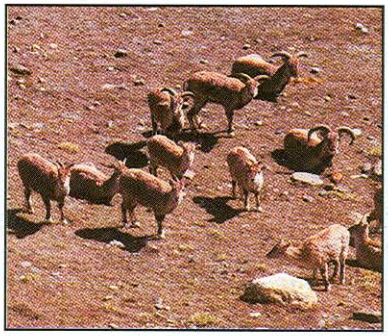
Gestation Period: 135-170 days.
Rutting: Mid-Dec to early Jan (varies between years and regions)
Young per Birth: 1 or 2, rarely 3.
Weaning: At 5-6 months
Sexual Maturity: At 1.5-2.5 years, although males do not reach their full potential before age 5-7
Life span: 12-13 years. Males rarely survive beyond their 7-8th year

The markhor is mainly active in the early morning and late afternoon. An intermediate forager, it consumes primarily grasses and forbs during spring and summer months, while in the winter it turns primarily to browse for nourishment. Markhor often stand on their hind legs in order to reach high vegetation; they are known to climb the gnarled trees for foraging. During the rut, males fight for breeding rights. These competitions involve lunging and locking the horns, followed by the combatants twisting and pushing in an attempt to make the other lose his balance.

Females and young live in herds of around 9 animals; adult males are usually solitary.

BHARAL, HIMALAYAN BLUE SHEEP, *Pseudois nayaur*, Hodgson 1833

Vernacular Names: *Knabo* (Ladakhi, Tibetan), *nabo* (Spiti), *bharal* (Hindi, Pahari)



S. Sathyakumar

Taxonomy

Family:Bovidae
Sub family: Caprinae
Tribe: Caprini

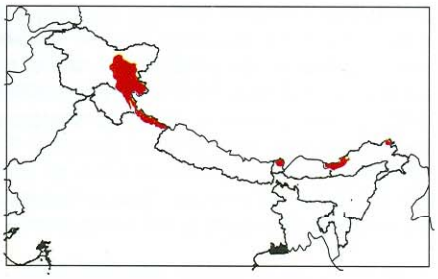
Conservation Status
IUCN: Low risk
CAMP: Low risk, least concern
IWPA: Schedule I
CITES: Not listed
US ESA: Not listed

Distribution & Habitat : Central Asian mountains - from Kunjereb in Pakistan in the west, to the Sichuan and Gansu provinces of China in the east, through bulk of the Tibetan plateau. Southern limit of distribution is along the Greater Himalayan chain in India, Nepal and Bhutan. Northern flank covers the Altai Shan, and parts of the Tien Shan. In India, found in Ladakh, Lahul-Spiti, and in some high alpine meadows of Kullu, Kinnaur, Uttaranchal, Sikkim, and the western Tawang region of Arunachal Pradesh covering *ca.* 30,000km^2. Most of these, apart from Ladakh and Lahul-Spiti, are narrow regions on the southern slopes of the Greater Himalaya itself.

Size
Body Length: 115-165 cm
Shoulder Height: 75-90 cm
Tail Length: 10-20 cm
Weight: 35-75 kg
Horn length: Male: 60-86cm
Female: 10-20cm

Description : The adult male's coat is slate grey, sometimes with a bluish sheen. The underparts and back of the legs are white, while the chest and fronts of the legs are black. Separating the grey back and white belly is a black coloured stripe. The ears are small, and the bridge of the nose is dark. The horns are found in both sexes, and have small ridges on the upper surface. In males, they grow upwards, then turn sideways and curve backwards, looking somewhat like a moustache. Females are light brown coloured with small horns, usually diverging at the top (important feature to distinguish with ibex females in areas where they are sympatric).

Behaviour : Bharal live at mid to high elevations, and may climb up to the vegetation line at 5,500m. In India, they usually occur between 2,500 and 5,500m, but usually below this upper limit. Uses primarily moderate to steep slopes, interspersed with 'escape terrain' in the form of rocky overhangs and cliffs, where they flee to escape predators such as snow leopard and the Tibetan wolf. Habitat similar to ibex but can occur in more open slopes and in much moister areas on the southern slopes of the Himalaya. In winter, may descend if possible or remain partial to south facing slopes and areas where snow deposition is relatively lower such as windblown ridgelines, crests and avalanche paths.



Occurs in small groups of less than 20 animals. Sexual segregation is most common in summer, when males may use more open meadows at higher elevations. Bharal are active during the day, with a bimodal peak during morning and late afternoon.

Intermediate forager, diet consists primarily of grasses, hardy herbaceous plants, also some shrubs.

S. Sathyakumar

Reproduction & Life Cycle
Gestation Period: 160-180days.
Rutting: Mating occurs between October and January, peaking for about 15-20 days.
Young per Birth: 1
Weaning: After 6 months.
Sexual Maturity: At 1.5 years, although males do not reach their full potential before age 7.
Life span: 12-15 years. Males rarely survive beyond their 7-8th year

LADAKH URIAL, *Ovis vignei vignei, Blyth 1841*

Vernacular Names: *Shapo* (male), *Shammo*, *Shanmar* (female) (Ladakhi)

Taxonomy

Family: Bovidae
Sub family:Caprinae
Tribe:Caprini

Conservation Status
IUCN: Endangered
CAMP: Endangered
IWPA: Schedule I
CITES: Appendix I
US ESA: Endangered

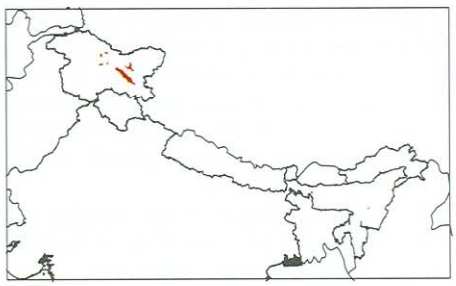
Y.V. Bhatnagar

Distribution & Habitat : A subspecies endemic to the Ladakh region. Occurs is relatively less steep and rolling slopes usually below 4,200m - mainly along the Indus River and the Shyok River and their tributaries. Within India, occurs along the Indus almost continuously from Upshi in the east till Dha-Hanu; a side population also occurs in the Wanla-Lamayuru-Nindum area towards the south and in the Markha Valley. The Shyok population is mostly concentrated around Tirit-Sumur and some occur further upstream along the Nubra River and along the Diskit-Khalsar area. Distribution in India covers *ca.* 2,000km^2. Small populations also reported from the Shigar valley, Gilgit and Skardu regions of PoK. Other related subspecies are distributed in the Kirthar, Safed Koh and Hindu Kush ranges in Pakistan and in parts of eastern Afghanistan and Tajakistan.

Description : Smallest wild sheep species. Adult urial are grey-brown in winter coat, but are rufous grey or brown during the rest of the year. Adult rams sport a black or grizzled ruff, which grows from the side of the chin and meets below and extends down the throat. The ruff is more pronounced during winter and in males older than about 5 years. In adult rams, a dirty white and indistinct saddle patch is present. They have a dark spot under the foreleg that may extend on to a lateral stripe in some males. Females are similar, but lack the saddle patch and invariable have just a dark spot under their forelegs. Underparts and rump patch in all age-sex classes are white. Male horns curve up, back, downwards and in large males turn a bit inwards. Females have short, parallel horns and are not divergent as in bharal and argali. Grey patches on face from the eye till the chin is present in both sexes.

Size
Body Length: 110-145 cm
Shoulder Height: 67-100 cm
Weight: 36-87kg
Horn length: Male: 50-100cm, Female 15-20cm

Behaviour : Ladakh urial are primarily animals of the lower slopes, usually below 4,200m; rarely occur up to 4,800m as in the proposed Nindum Wildlife Sanctuary. Occur on gradual to moderate slopes, but have probably been pushed to use steeper and rockier gorges along the side valleys of Indus due to excessive anthropogenic pressures. Has long, lithe limbs that facilitate fast flight from potential danger. They are also known to retreat into cliffs or steep slopes to escape predators such as wolf and snow leopard. Usually occur in small groups of 5-12 animals, however, in certain areas and in seasons such as spring may occur in larger groups of *ca.* 80 animals. Sexual segregation is reported during much of the year barring the rutting period.



Is an intermediate forager, consuming grasses, forbs and shrubs in different seasons. During the rut, solitary males may travel vast distances in search of oesterous females. Contests between males are in the typical form of sheep, where two opposing rams clash into each other from some distance producing a loud clack. They may then involve in shoulder pushing and horn entwining.

Y.V. Bhatnagar

Reproduction & Life Cycle

Gestation Period: 155-180 days.
Rutting: Peaks for about 15 days in Nov to Jan (varies between years and regions)
Young per Birth: 1 or 2
Sexual Maturity: At 1.5-2 years, although males do not reach their full potential before age 5
Life span: Up to 10-15 years. Males rarely survive beyond their 7-8th year

TIBETAN ARGALI, *Ovis ammon hodgsoni, Blyth 1840*

Vernacular Names: Nayan, nyan (Ladakh, Tibetan, Spiti)

Taxonomy

Family: Bovidae
Sub family: Caprinae
Tribe: Caprini

Conservation Status
IUCN: Vulnerable
CAMP: Critically endangered
IWPA: Schedule I
CITES: Appendix I
US ESA: Endangered

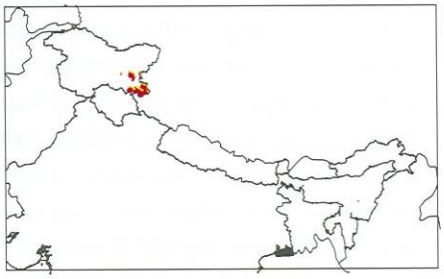
T. Namgail

Distribution & Habitat : Open, rolling high altitude slopes and plateaus in Central Asia. Different subspecies are spread from the Pamirs in the west to the eastern Tibetan plateau; and from the areas just north of the Greater Himalaya, to Mongolia, in the north. In India less than 300 might be surviving in its range in Ladakh with smaller portions of the range also covered in Sikkim, totaling to *ca.* 12,000km^2.

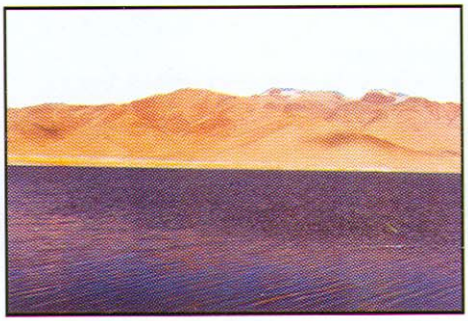
Description : Largest wild sheep in the world. Long limbs, with a pronounced shoulder and a large chest. The general colouration of argali is variable, ranging from a light buff to darker grey-brown in winter. The underparts are whitish, usually separated from the darker parts by a blackish stripe. In addition, males have a whitish neck ruff, and a dorsal crest, both of which are more prominent in the winter coat. Argali has a whitish, large rump patch. Adult males carry two enormous, ribbed, horns, which turn upwards, back, down, and then forward and outwards and can reach 145-190 cm when measured along the spiral. The basal circumference of the horns may measure up to 40cm. Females also bear horns, although these are much smaller, rarely exceeding 30cm in length. These are however thicker and more divergent than other sympatric caprine female horns.

Size
Body Length: 120-200 cm
Shoulder Height: 90-120 cm
Weight: 65-180 kg (Male 110kg, female 68kg)
Horn length: Male: 145-190cm; Female: 25-30cm

Behaviour : Usually occurs at the highest elevations in the Tibetan Plateau (4,500-5,500m), using the open mesic alpine meadows. While local migrations may occur in autumn and spring, argali may not descend much in winters, but may chose areas with less snow (they primarily occur is regions where winter precipitation is naturally not very high). With relatively long legs, argalis are fast runners and flee away from their primarily cursorial predators, the Tibetan wolf. However, refuge is occasionally taken on steep mountain slopes. The primary vocalizations are an alarm whistle and a warning hiss made by blowing air through the nostrils. When competing, males rear up on their hind legs and, leaning forward, race towards their opponent, crashing horns in the process.



Occur usually in small groups 2-15 animals, but occasional aggregations of about 40 animals also reported. Herds are sexually segregated for most of the year, except the rutting season. Is an intermediate forager feeding on herbs, sedges, grasses and shrubs. Some recent studies suggest that they rely to a greater extent on forbs and shrubs.



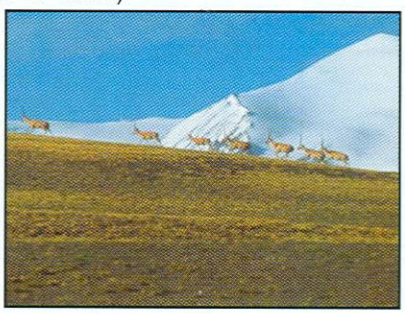
Y.V. Bhatnagar

Reproduction & Life Cycle
Gestation Period: 150-160 days.
Rutting: Peaks for about 15 days in Nov to Jan (varies between years and regions)
Young per Birth: 1, rarely 2
Weaning: At 4-6months
Sexual Maturity: Females at 2 years, males by 5 years.
Life span: 10-13 years.

Another subspecies, *O.a. polii*, or the Marco Polo Sheep also occurs in the Hunza region of Pakistan Occupies Kashmir. This is a magnificent animal with large corkscrew like horns, that are up to a metre wide at the tips.

TIBETAN ANTELOPE, *Pantholops hodgsonii, Abel 1826*

Vernacular Names: *Tstosh* (Ladakhi, Tibetan), *chiru* (parts of Tibet)



J.L. Fox

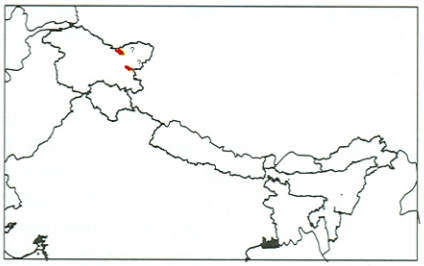
Taxonomy

Family: Bovidae
Sub family: Panthalopinae
Tribe: Saigini

Conservation Status
IUCN: Endangered
CAMP: Critical
IWPA: Schedule I
CITES: Appendix I
US ESA: Not listed

Distribution & Habitat : The Tibetan steppe at elevations of 4,000-5,500 metres in open, plains and rolling mountains. Occurs in the Chang Thang plains in northern Tibet, Xinjiang and Qinghai. Smaller populations occur in central Tibet. Small groups of female and young from the northern Chang Thang population from Tibet are known to migrate into Indian territories in the Aksai Chin (Daulat Beg Uldi-Lingti-Tsiang plains) and males in the Changchenmo valley during June till autumn. The combined distribution range within India will be less than 300km^2.

Size
Heat-tial length: 170cm
Shoulder Height: 83-100cm
Weight: 25-40 kg
Horn Length (male): 50-70cm



Description : The dense coat is very soft and woolly, and is very good insulation against the cold Tibetan weather. The coat of adult males is reddish fawn with light grey and brown tones grading to creamy white undersides. The fronts of the slender legs and the face (including the forehead, bridge of the nose, and upper cheeks) are dark brown. By October the males acquire the more striking winter pelage. The face and the front of the legs are now black, and the marking from the foreleg goes over the shoulder and from the hindlegs extends around the margins of the rump patch. The rest of the body is light gray and tan. Females are smaller, and the coat is fawn-almost pinkish, often with rust brown in the nape that blends into the lighter underside. Males alone carry the slightly S-shaped horns which grow 50-70 cm in length. Black in colour and ridged on their lower half, they rise nearly vertically from the head. Another distinctive feature is the presence of walnut sized airsacs on each side of the nostril, that gives the muzzle a blunt and enlarged look. The fawn-coloured underwool or shahtoosh produced by this species is the finest wool known to man.

Reproduction & Life Cycle

Gestation Period: Approx. 6 months
Rutting takes place in early winter (November-December), and the young are born in May and June.
Young per Birth: 1 or 2.
Weaning: Unknown.
Sexual Maturity: At 1.5-2.5 years.
Life span: Probably 10-15 years

TIBETAN GAZELLE, *Procapra picticaudata, Hodgson, 1846*

Vernacular Names: *Gowa* (Ladakhi, Tibetan)

Y.V. Bhatnagar

Taxonomy

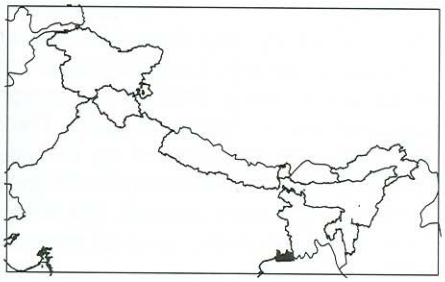
Family: Bovidae
Sub family: Antilopinae
Tribe: Antilopini

Conservation Status
IUCN: Low risk
CAMP: Critical
IWPA: Schedule I
CITES: Not listed
US ESA: Not listed

Distribution & Habitat :Open, rolling plateaus, slopes and valleys, with mesic alpine meadow/steppe vegetation communities, usually above an elevation of 4,200m. Global range extends in much of the Tibetan Plateau and the Xinjiang, Quinghai and Gansu provinces of China. In India, small populations occur in 3, possibly 4 places in eastern Ladakh (Hanle, Chushul, Chumur and Changchenmo) and northern parts of Sikkim (near Gyaum Chhona and Changri meadows). The overall occurrence may be in less than 500km^2 in the country.

Size
Shoulder Height: 60-65cm
Weight: 13-15kgs
Horn length (Male):
mean-29cm (26-32cm)

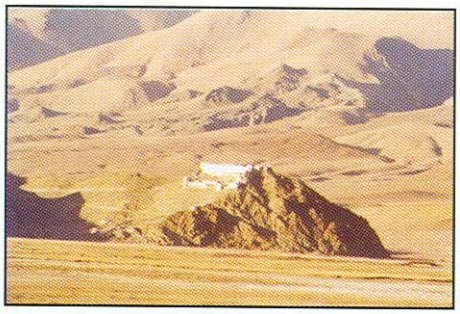
Description : The gazelle is a small animal with slender legs weighing between 13 and 15kg. Its coat varies from sandy brown to grayish brown, and is greyer in summer. The underparts and insides of the legs are white. A prominent feature is the large white heart shaped rump patch, which covers much of the rump. A rust-brown band surrounds the rump patch. Only males have horns. These slender horns go up, curve back and then up again. They are ridged till the distal quarter and are slightly divergent at the top and may again bend inwards.



Behaviour : Species of the open plateaus and mountains occurring between elevations of 4,200 and 5,500m. Primarily occur in the mesic alpine meadows and steppe vegetation. Rarely also occurs in desert steppes. Is a lithe animal that relies on quick detection and flight from predators like the Tibetan wolf and, and rarely wild dog and snow leopard. Little altitudinal migration is reported, but generally occur in their lowest range in the spring. Winter is a hard time for this small ungulate, especially in years with heavy snowfall when heavy mortality may occur.

The gazelle usually occurs in small groups of 4-5 animals, and rarely larger concentrations may occur. In India the total population is likely to be less than 50 in three small populations and seeing large groups any where is extremely difficult. During rutting, males may hold small territories where they maintain small harems. These sites are often marked by 'laterine sites'.

The gazelle tends to be a 'concentrate forager' feeding on more nutritious forbs and lush sedges during all periods, except winter, when it switches to the only forage which is coarse for its survival.



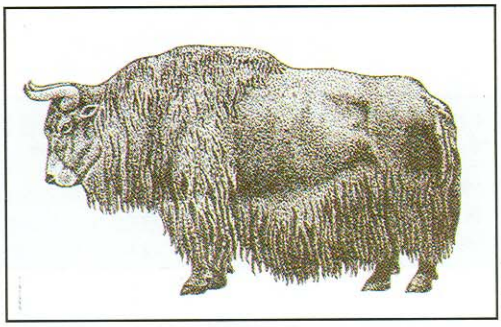
Y.V. Bhatnagar

Reproduction & Life Cycle

Head-Body length: 90-105cm
Gestation Period: 155-180 days.
Rutting: Peaks for about 15 days in Jan (varies between years and regions)
Young per Birth: 1
Weaning: Gradual, without a sharp cutoff.
Sexual Maturity: At 1.5-2 years

YAK, *Bos grunniens, Linnaeus 1766*

Vernacular Names: *Dong* (Ladakhi, Tibetan)



C.E.E.

Taxonomy
Family: Bovidae
Sub family: -
Tribe: Bovini

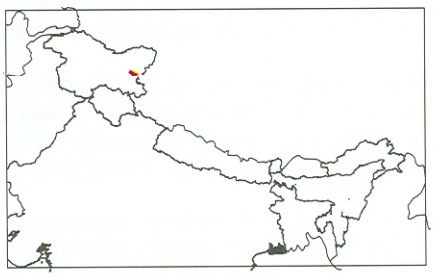
Conservation Status
IUCN: Vulnerable
CAMP: Critical
IWPA: Schedule I
CITES: Not listed
US ESA: Endangered

Distribution & Habitat : Montane regions of Tibet at an altitude of 4,000-5,400m on relatively moist grass and sedge dominated slopes and valleys. Distribution is somewhat restricted compared with other Tibetan ungulates to the northern parts of Tibetan Chang Thang, extending into the Xinjiang province in the north and the western extremity of the Quinghai province. Good populations are reported from the Aru Basin in the Changthang Nature Preserve. In India, the distribution is restricted to small portions in the Changchenmo valley in Ladakh, just north of the Pongong Tso where some 40 animals may exist.

Description : The dark black-brown coat is dense, wooly, and extremely shaggy, although the colour is variable in domestic yaks. 'Golden' wild yaks are also known, but are rare. The shoulders are high and humped, with a broad, drooping head. The short legs have broad hooves and large dewclaws as an adaptation to mountainous environments. Long mantles of hair drape down from the neck and flanks, often almost completely covering the legs. The tails are large and bushy. The horns are found in both sexes, though those of the females are considerably smaller and shorter. The curved horns grow out from the sides of the head and curve upwards. The wild yak horns are on an average larger than the domestic ones and have a distinctive white splashes on the muzzle.

Size
Body Length: cow-305cm, bull 350-380cm
Shoulder Height: 200cm (135-205cm)
Weight: Male 535-820kg; Female 305kg
Horn length: Male: 95cm, Female 51cm

Behaviour : Occur at high elevations (4,000 to the limit of vegetation at *ca.* 5,400m) on mesic to moist meadows and rarely on more arid areas. Prefers rolling slopes and flat plains or plateaus. Coarse/bulk forager requiring lot of forage every day, it survives on grasses, sedges, and occasionally lichens and tubers. Due to the scarcity and unpredictability of vegetation in their habitat, wild yaks must travel great distances in order to obtain sufficient nourishment. In July, there is a general downward shift from the high plateaus to the lower plains, where swamp vegetation is at their peak growth. As the temperature rises in August, the herds head back up to the plateaus, even retiring to snowy regions to beat the heat. Although sensitive to warm temperatures, wild yaks can easily tolerate temperatures of -40°C. Generally wary, if a herd is disturbed they will flee for a long distance, galloping with their tails held erect. The only natural predator is the Tibetan wolf, but may have limited success of killing an adult yak. When cornered, or when young are present in the group, yaks may actively defend them against any potential danger. In spite of their bulky, awkward appearance, yaks are excellent, sure-footed climbers. One of the few vocalizations is a loud grunt, made during the breeding season by wild yaks. Domestic yaks, however, "grunt" throughout the year - hence the specific name 'grunniens'.



Solitary animals and herds of 10-50 are most common; occasionally 200 individuals are also seen. Aggregations of over 80 animals are commonly seen in some areas such as the Aru basin in Tibet.

Reproduction & Life Cycle

Gestation Period: *ca.* 258 days
Rutting: September
Young per Birth: 1 usually born in June
Weaning: About 1 year
Sexual Maturity: By 6 years
Life span: 23 years

TIBETAN WILD ASS OR KIANG, *Equus kiang*

Vernacular Names: *Kiang* (Ladakhi, Tibetan)

Taxonomy

Family: Equidae
Sub family: -
Tribe: -

Conservation Status

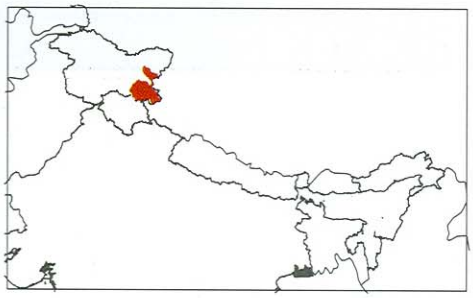
IUCN: Data deficient
CAMP: Vulnerable
IWPA: Schedule I
CITES: Appendix II
US ESA: Not listed

Y.V. Bhatnagar

Distribution & Habitat : Occurs all along the rolling mountains and valleys of the Tibetan Plateau between 4,000 and 5,200m. Distributed from Ladakh in the west to the Quinghai province of China in the east; and from the plateau regions on the northern fringe of the Greater Himalaya, till the Xinjiang province of China. In India, kiang are reported from the Chang Thang plateau of Ladakh and the northern cold desert areas of Sikkim.

Size
Shoulder Height: 142cm
Weight: Male 350-400kg;
Female 250-300kg

Description : The largest of the wild asses, the kiang is a robust animal. The head is large, the muzzle blunt and the nose convex. The mane is upright and relatively short. The coat is a rich chestnut colour or dark brown in winter, turning to reddish brown in summer. The legs, the ventral part of the body, including the neck, inside of the ears and the muzzle are white. A dark dorsal stripe extends from the neck till the base of the tail. The tips of the ears and a narrow band along the hooves are also black. Little sexual dimorphism exists in the species, but the males are slightly larger than females.



Behaviour : Occurs usually from 4,000m till the limit of vegetation at *ca.* 5,200m, but within this range it is largely confined to flat plains, plateaus and rolling smooth slopes. Kiang use alpine meadows and alpine steppes dominated by grasses and sedges, but also occur on drier desert steppes. Kiang may show minor seasonal migrations, most of it being altitudinal - migrating to higher regions in summer and to lower ones in winter. Within the Indian region, kiang are often seen in the moister wide river valleys and lake basins of the Chang Thang during the winter; an area also used by the nomadic domestic sheep-goat herders of the region. Kiang is large and swift-footed animal and predation on adults by wild carnivores is rare. The natural predator of the region is the Tibetan wolf; and man also takes a toll - hunting of kiang is still known to be prevalent in Tibet, but not in the Indian parts of its range. On approaching, kiang typically flee with its head up and wheel around after running 80-100m to look back at the potential danger. Often, they appear inquisitive and begin approaching the intruder.

Reproduction & Life Cycle

Gestation Period: 355 days, 11-12months
Rutting & births: July-August
Young per Birth: one
Sexual Maturity: 2-3years
Life span: *ca.* 10-11years, rarely more

Kiang normally occurs in small groups of 8-10 animals. Solitary animals, mostly stallions are also common. Occasionally, they may form large aggregations of 200-300 animals. Such aggregations are most common during autumn and winter when animals congregate on meadows with better forage quantity. Males tend to maintain small temporary harems during the rutting period and may rarely also show site fidelity suggesting some territoriality in the species.

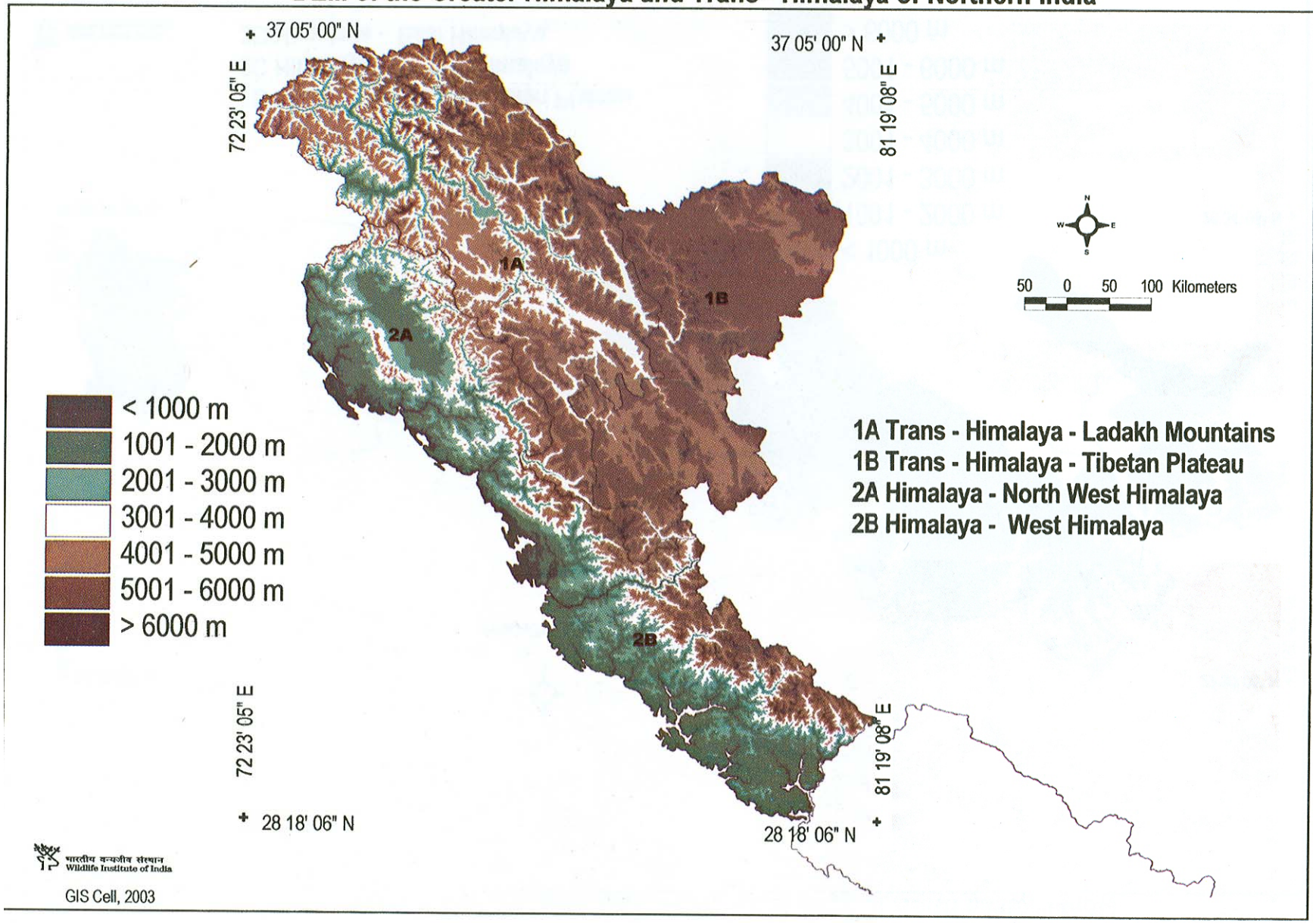
Kiang are 'bulk foragers' and require larger quantities of forage, but not necessarily of good quality. Thus, it survives on relatively poor quality diet of sedges and grasses during the entire year.

Female Characters

Unlike males, Caprini females are often difficult to identify due to their similarities. Here are a few cues to distinguish between them.

- In general, *Capra* females have a more stocky built compared to *Ovis* & *Pseudois*.
- Ibex females have thin and parallel horns - usually larger than most *Ovis* (except argali) and *Capra*; have a distinct dark lateral stripe; often females also have a small beard
- Bharal are similar, but the horns are slightly divergent
- Urial horns are similar to ibex, but the horns are shorter and instead of a lateral stripe, they have just a black spot under the foreleg
- Argali females are bigger than all other similar *Ovis* and *Capra*. The horns are relatively large and divergent
- Markhor females have slightly divergent and twisted horns; lateral stripe is thin and sometimes indistinct.

DEM of the Greater Himalaya and Trans - Himalaya of Northern India



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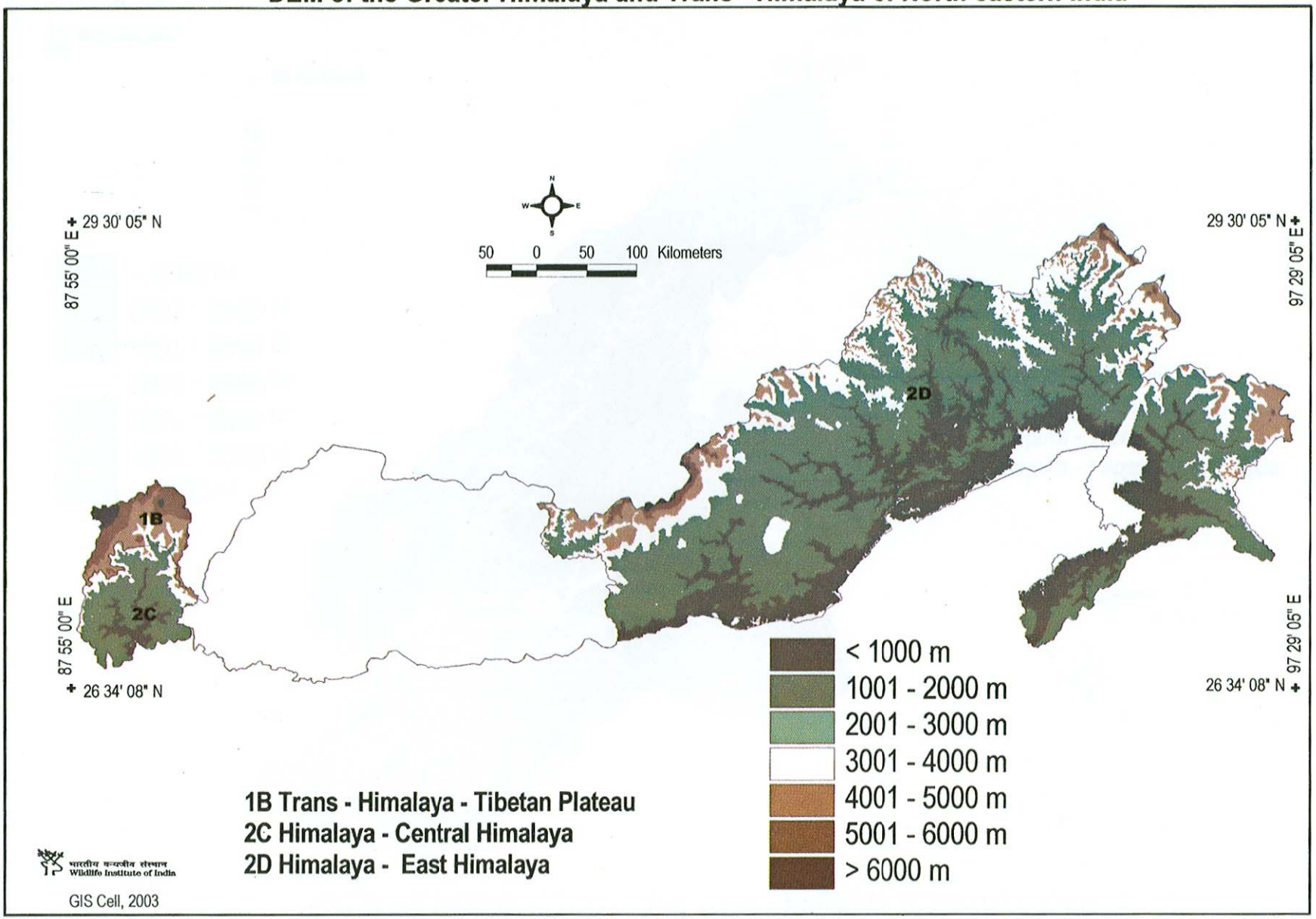
Wildlife Institute of India

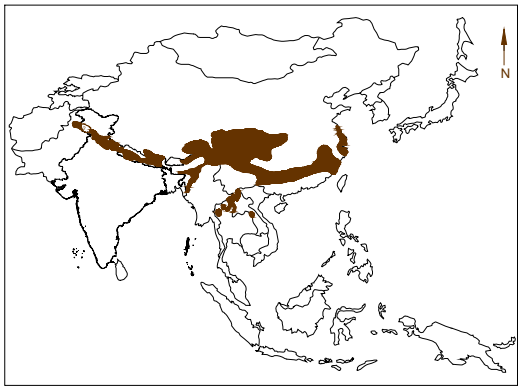
GIS Cell, 2003

DEM of the Greater Himalaya and Trans - Himalaya of North eastern India

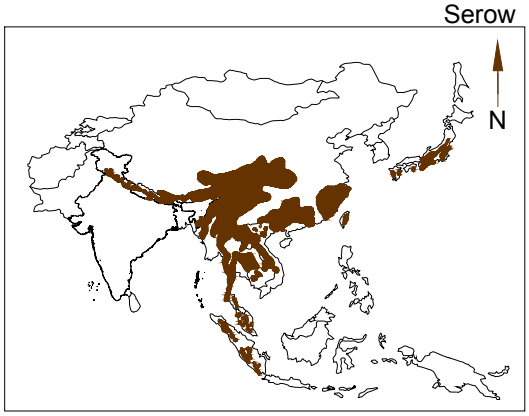


Mountain Ungulates - Global Distribution

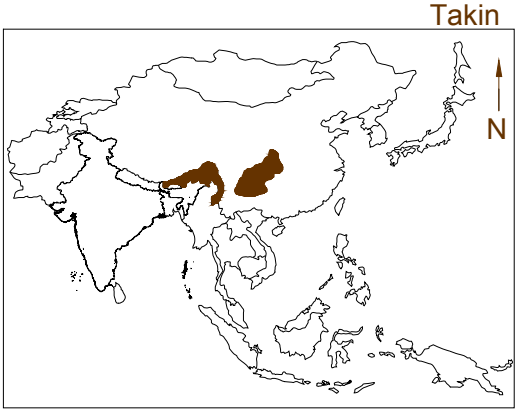
Goral



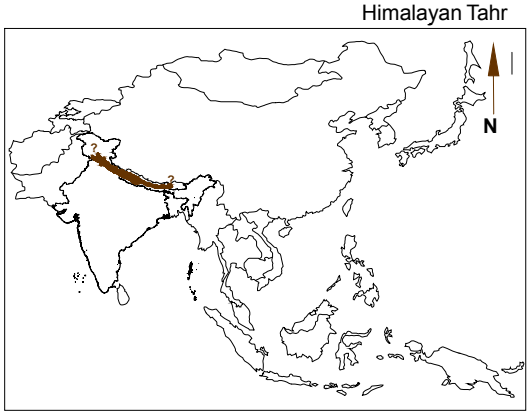
Serow



Takin

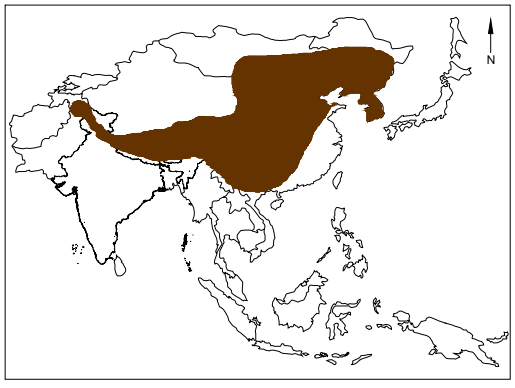


Himalayan Tahr

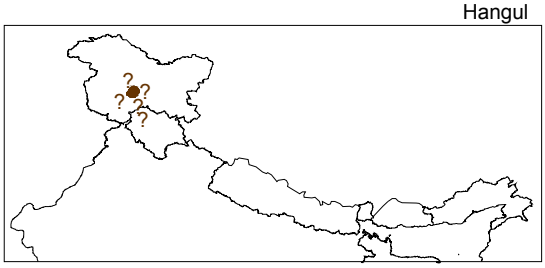


Introduced populations in New Zealand and South Africa

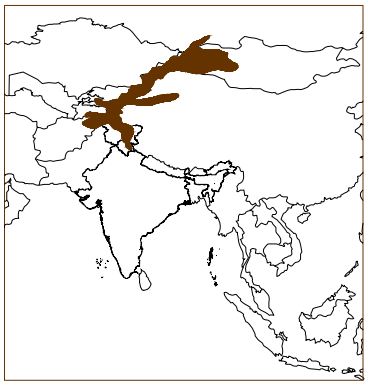
Musk Deer



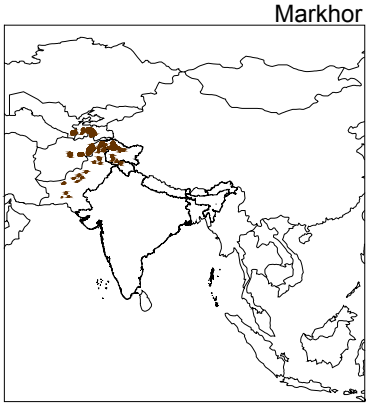
Hangul



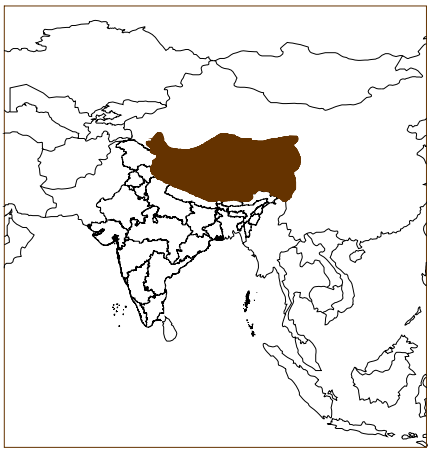
Ibex



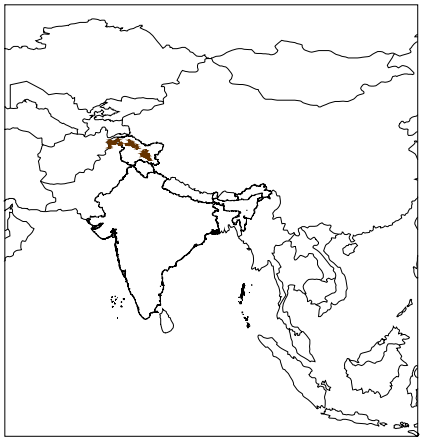
Markhor



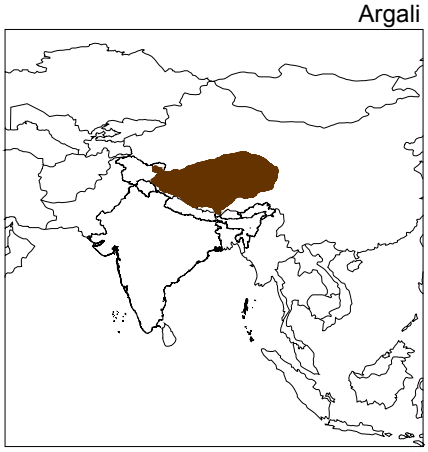
Bharal or Blue Sheep



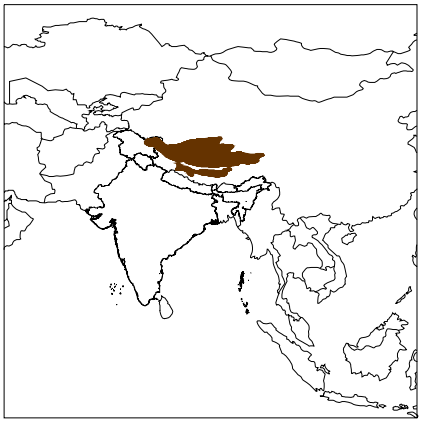
Urial



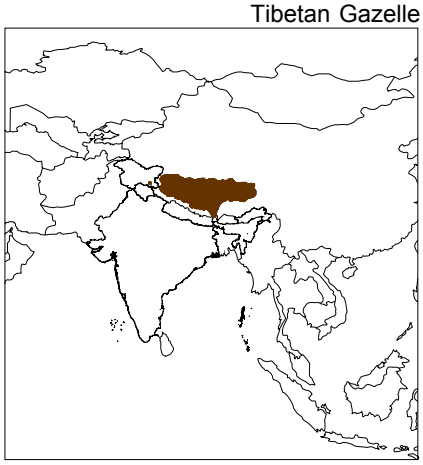
Argali



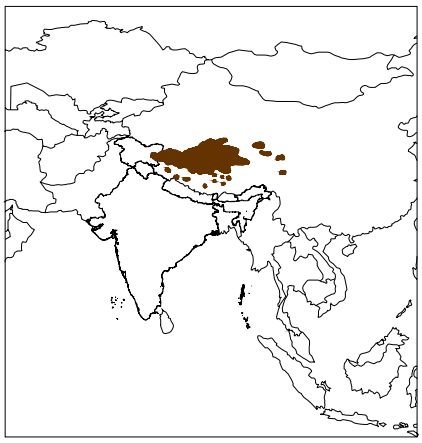
Tibetan Antelope



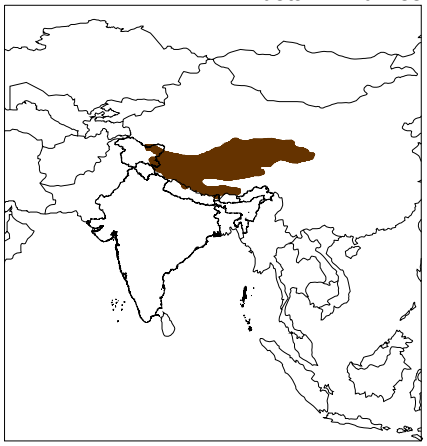
Tibetan Gazelle



Yak



Tibetan Wild Ass



Chapter 3

Mountain Ungulates in the Himalayan and Trans-Himalayan Protected Areas of India

J.S. Kathayat & V.B. Mathur

In all, 20 ungulate species belonging to four families *viz*., *Cervidae*, *Moschidae*, *Bovidae* and *Equidae* occur in the Himalaya. Of these, three species, *viz*., Sambar, Barking deer and Wild pig are widely distributed in the India and are not confined to the Himalayan region alone. The Himalayan ungulates are represented by 17 species and the members of the Sub Family Caprinae dominate (9 species). About 5,13,089 km^2 of India's geographical area is covered by the Himalayas and the hills of north-east India. There are about 75 Protected Areas (PAs) covering approximately 40,329.65 km^2 (7.86% of the region) in which the mountain ungulates occur. These include: 6 PAs in the Trans-Himalayan zone, 58 in the Himalayan zone, 3 in the Gangetic Plain, and 8 in North-East India. The Central Himalayan province (2C) has the highest percentage of PA coverage while the province of North-East Hills (9B) has the lowest PA coverage (Table 1).

1. Protected Area Coverage

a. PA Coverage in different Biogeographic Regions

An analysis of area covered under the PA network in each biogeographic zone (*i.e*, area available for conservation of mountain ungulates and other species) reveals that the Eastern Himalaya (2D) has the highest (10,700.57 km^2) coverage while the North-East Hills has the lowest (1,249.69 km^2). The area covered under the PA network in other provinces are as follows: 1A - Ladakh Mountains (9,775 km^2), 2B - West Himalaya (6,028.48 km^2), 1B - Tibetan Plateau (5,443 km^2), 2A - North-West Himalaya (3,419.09 km^2), 2C - Central Himalaya (2,071.82 km^2) and in 7A - Upper Gangetic Plain (1,642 km^2) (Table 2).

b. PA Size Distribution (for some selected species)

The mountain ungulate species found in various PAs and the potential areas available for each species are as follows: Himalayan ibex reported in 8 PAs (11,854.70 km^2), Ladakh urial in 2 PAs (9,100 km^2), Tibetan argali in 2 PAs (8,100 km^2), Bharal in 17 PAs (17,540.76 km^2), Tibetan wild ass in 1 PA (4,000 km^2), Himalayan musk deer in 37 PAs (17,831.48 km^2), Hangul in 5 PAs (1,178 km^2), Himalayan tahr in 17 PAs (5,953.61 km^2), Goral in 54 PAs (22,757.08 km^2), Serow in 43 PAs (18,434.61 km^2), Markhor in 1 PA (400 km^2), Takin in 6 PAs (5,561.50 km^2).

The mean PA size for PAs in Provinces 2A and 9B are low while it is higher for 1A and 1B (Table 3). Over 36% of these PAs are <100 km^2 and about 40% PAs are in the category of 101-500 km^2 (Figure 1) In

other words, 76% of PAs that afford protection to mountain ungulates are smaller in size. There is a need for large PAs to maintain viable populations of mountain ungulates for long-term conservation.

2. Ungulate Species Richness in Protected Areas

Goral seems to be the most common mountain ungulate in the Himalaya as it is reported from 54 PAs, while the Tibetan wild ass and Markhor are found only in one PA each. Information on the distribution of species such as Tibetan gazelle, Chiru and Wild yak is lacking.

The highest mountain ungulate species richness is in the biotic province North-west Himalaya (8 species) and the minimum species richness is in the biotic province Upper Gangetic Plain (1 species). The state of Jammu & Kashmir has the most number of mountain ungulate species (10 species) while the states of Nagaland and Manipur have the least (1 species each).

Information on the PAs for the conservation of the mountain ungulates in the Himalaya and Trans-Himalaya is presented in Tables 1 to 3.

Authors' Note: The above analyses is based on the data available in the National Wildlife Database of the Wildlife Institute of India, provided by PA managers/states and has a some limitations *viz*., (1) Some species populations exist outside the PA network (2) The presence of a few species are yet to be confirmed from some PAs (3) The total area of the PA may not be the potential area for the mountain ungulate species as this includes perpetual snow covered areas and altitudinal range limits not used by the species. (4) A few PAs have the 'proposed' status *i.e*. they have not been gazetted.

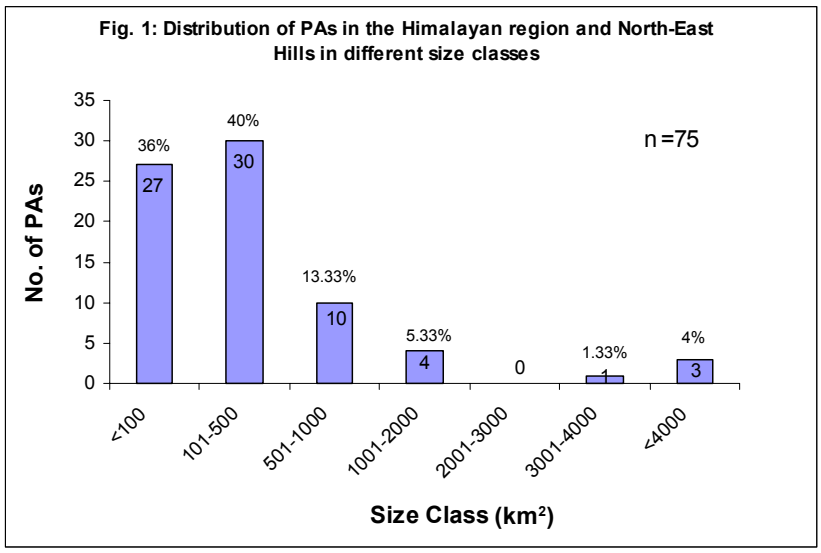


Table 1. Distribution of Mountain Ungulates in various Protected Areas in India

Biogeographic Zone	Biogeographic Province	State	Protected Area	Year of Establishment	Area (km^2)	Altitudinal Range (m)	Himalayan Musk deer	Hangul	Takin	Himalayan Tahr	Goral	Serow	Markhor	Himalayan Ibex	Ladakh Urial	Tibetan Argali	Bharal	Tibetan Gazelle	Chiru	Tibetan Wild ass	Wild Yak
1	1A	Jammu & Kashmir	Hemis NP	1981	4100	3140-5854	x	x	x	x	x	x	x	✓	✓	✓	✓	x	x	x	x
			Karakoram WS	1987	5000	*ca* 2600-6500	x	x	x	x	x	x	x	✓	✓	?	?	x	x	x	x
		Himachal Pradesh	Pin Valley NP	1987	675	3300-6632	x	x	x	x	x	x	x	✓	x	x	?	x	x	x	x
	1B	Jammu & Kashmir	Changthang WS	1987	4000	*ca* 4200-6000	x	x	x	x	x	x	x	x	x	✓	✓	?	x	✓	x
		Himachal Pradesh	Kibber WS	1992	1400	*ca* 4200-6000	x	x	x	x	x	x	x	✓	x	x	✓	x	x	x	x
		Sikkim	Shingba Rhododendron WS	1984	43	3048-4575	✓	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
2	2A	Jammu & Kashmir	Baltal-Thajwas WS	1987	210		x	?	x	x	x	x	x	x	x	x	x	x	x	x	x
			Dachigam NP	1981	141	1642-4289	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x
			Gulmarg WS	1987	180	2400-4300	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x
			Hirapora WS	1987	114.5	2557-4745	?	x	x	x	x	✓	?	x	x	x	x	x	x	x	x
			Kishtwar NP	1981	400	1700-4800	✓	✓	x	x	✓	✓	✓	x	x	x	✓	x	x	x	x
			Lachipora WS	1987	93.5	1630-3300	✓	x	x	x	x	x	?	x	x	x	x	x	x	x	x
			Overa WS	1981	32	2100-5425	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x
			Overa-Aru WS	1987	425	2250-6000	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x	x
			Trikuta WS	1981	31.73	450-600	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			City Forest NP	1992	9.07		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Limber WS	1987	43.75		✓	x	x	x	x	x	?	x	x	x	x	x	x	x	x
			Hokersar WS	1992	13.75	1584	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		Himachal Pradesh	Bandli WS	1962	41.32	762-2160	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Gamgul-Siahbehi WS	1962	108.85	1800-3919	✓	x	x	✓	✓	✓	x	x	x	x	x	x	x	x	x
			Great Himalayan NP	1984	754.4	1500-5805	✓	x	x	✓	✓	✓	x	?	x	x	✓	x	x	x	x
			Kais WS	1954	14.19	2800-3680	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Kalatop-Khajjair WS	1958	61	1185-2768	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Kanwar WS	1954	54	1800-4833	✓	x	x	✓	✓	✓	x	x	x	x	?	x	x	x	x
			Khokhan WS	1954	14.05	1500-2787	x	x	x	✓	x	x	x	x	x	x	x	x	x	x	x

			Kugti WS	1962	378.86	2250-6044	✓	x	x	x	x	x	x	✓	x	x	?	x	x	x	x
			Lippa Asrang WS	1962	30.89	4000-5022	✓	x	x	x	✓	x	x	✓	x	x	✓	x	x	x	x
			Manali WS	1954	31.8	2273-5300	?	x	x	?	x	x	x	?	x	x	?	x	x	x	x
			Nargu WS	1962	278.37	970-4034	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Rupi Bhaba WS	1982	269	909-5650	✓	x	x	x	✓	✓	x	?	x	x	✓	x	x	x	x
			Sechu Tuan Nala WS	1962	102.95	2550-6072	✓	x	x	✓	✓	✓	x	✓	x	x	?	x	x	x	x
			Shikari Devi WS	1962	72	1800-3359	?	x	x	?	x	x	x	x	x	x	x	x	x	x	x
			Tundah WS	1962	64.22	2074-5532	✓	x	x	✓	x	x	x	?	x	x	?	x	x	x	x
			Tirthan WS	1992	61.12	2100-4875	✓	x	x	✓	✓	x	x	?	x	x	x	x	x	x	x
			Sainj WS	1994	90		x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
	2B	Himachal Pradesh	Chail WS	1976	108.54	701-2408	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Churdhar WS	1985	56.15	2000-3647	✓	x	x	✓	✓	x	x	x	x	x	x	x	x	x	x
			Daranghati WS	1962	167	2100-3315	✓	x	x	✓	✓	x	x	✓	x	x	x	x	x	x	x
			Darlaghat WS	1962	140	1075-2069	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Majathal WS	1954	40	900-1966	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Sangla WS	1989	650	3200-5486	✓	x	x	x	x	x	x	x	x	x	✓	x	x	x	x
			Shilli WS	1963	2.13	1230-1845	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Shimla Water Catchment WS	1958	10.25	1900-2620	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Talra WS	1962	26	1500-3324	✓	x	x	✓	x	x	x	x	x	x	x	x	x	x	x
		Uttaranchal	Askot Musk Deer WS	1986	599.93	2400-5000	✓	x	x	✓	✓	✓	x	x	x	x	✓	x	x	x	x
			Binsar WS	1988	45.59	2000-3000	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Gangotri NP	1989	1552	1800-7083	✓	x	x	x	✓	x	x	x	x	x	✓	x	x	x	x
			Govind NP	1990	472.08	1400-6323	✓	x	x	?	✓	✓	x	x	x	x	✓	x	x	x	x
			Govind Pashu Vihar WS	1955	481	1400-6323	✓	x	x	✓	✓	✓	x	x	x	x	✓	x	x	x	x
			Kedarnath WS	1972	957	1160-7068	✓	x	x	✓	✓	✓	x	x	x	x	x	x	x	x	x
			Nanda Devi NP	1982	624.62	3500-7816	✓	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x
			Valley of Flowers NP	1982	87.5	3267-6727	✓	x	x	✓	✓	x	x	x	x	x	✓	x	x	x	x
			Mussoorie WS	1993	10.82	2005	x	x	x	✓	✓	✓	x	x	x	x	x	x	x	x	x
	2C	Sikkim	Fambong Lho WS	1984	51.76	1375-2650	?	x	x	x	x	?	x	x	x	x	x	x	x	x	x
			Maenam WS	1987	35.34	1600-3250	✓	x	x	x	✓	✓	x	x	x	x	✓	x	x	x	x
			Khangchendzonga NP	1977	1784	1829-8585	✓	x	x	✓	✓	✓	x	x	x	x	✓	x	x	x	x
			Kyongnosla Alpine WS	1977	31	3292-4116	✓	x	✓	x	✓	✓	x	x	x	x	x	x	x	x	x
			Barsey Rhododendron WS	1998	104	1600-3600	✓	x	x	x	✓	?	x	x	x	x	x	x	x	x	x
		West Bengal	Jorepokhri WS	1985	0.04	?-1800	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
			Neora Valley NP	1986	88	3040-3200	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Senchal WS	1976	38.88	1500-2600	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Singalila WS	1986	78.6	2290-3650	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x

	2D	Arunachal Pradesh	D'Ering WS	1978	190	100-250	x	x	?	x			x	x	x	x	x	x	x	x	x
			Dibang WS	1991	4149	1500-5000		x		x			x	x	x	x	x	x	x	x	x
			Eagle Nest WS	1989	217	1100-2980	x	x	x	x			x	x	x	x	x	x	x	x	x
			Itanagar WS	1978	140.3	210-1164	x	x	x	x			x	x	x	x	x	x	x	x	x
			Kamlang WS	1989	783		x	x	?	x			x	x	x	x	x	x	x	x	x
			Mehao WS	1980	281.5	330-3560		x		x			x	x	x	x	x	x	x	x	x
			Lado WS (proposed)		500	2500-5000	x	x		x			x	x	x	x	x	x	x	x	x
			Mouling NP	1986	483	700-3060		x	?	x			x	x	x	x	x	x	x	x	x
			Namdapha NP	1983	1807.82	200-4500		x	?	x			x	x	x	x	?	x	x	x	x
			Pakhui WS	1977	861.95	150-1900	x	x	x	x			x	x	x	x	x	x	x	x	x
			Palin WS (proposed)		250	2000-2800	x	x	?	x			x	x	x	x	x	x	x	x	x
			Sessa Orchid WS	1989	100	800-3100	x	x	x	x			x	x	x	x	x	x	x	x	x
			Tale Valley WS	1995	337	1500-2700	x	x	?	x			x	x	x	x	x	x	x	x	x
			Kane WS	1991	55		x	x	?	x	?	?	x	x	x	x	x	x	x	x	x
			Yardi-Rabe Supse WS		491.62		x	x	?	x	?	?	x	x	x	x	x	x	x	x	x
			Tawang NP/WS (proposed)		300	2000-5000		x		x			x	x	x	x		x	x	x	x
			Walong WS (proposed)		300	2000-5000	x	x		x			x	x	x	x	x	x	x	x	x
7	7A	Uttaranchal	Corbett NP	1936	520.82	250-1000	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Rajaji NP	1983	820	302-1000	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
			Sonanadi WS	1987	301.18	385-1100	x	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
9	9B	Manipur	Yangoupokpi-Lokchao WS	1989	184.8	1000-2100	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
		Meghalaya	Balphakram NP	1985	220	192-1023	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Nokrek Ridge WS	1986	47.48	600-1412	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
		Mizoram	Dampa WS	1985	500	500-1090	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Murlen NP	1991	200	1000-1500	x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
			Khawnglung WS	1992	41	400-1300	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
			Phawngpui WS	1992	50		x	x	x	x	✓	✓	x	x	x	x	x	x	x	x	x
		Nagaland	Fakim WS	1980	6.41	2000-2729	x	x	x	x	x	✓	x	x	x	x	x	x	x	x	x
							37	**5**	**6**	**17**	**54**	**43**	**1**	**8**	**2**	**2**	**17**	**0**	**0**	**1**	**0**

N.B.: The information presented here is collated from the National Wildlife Database at WII which is updated by information from PA Managers and other secondary sources. Two species, viz., Wild goat (*Capra aegarus*) and Sikkim stag (*Cervus elaphus wallichi*) are not included in the matrix as they have not been reported from any PA in India.

Table 2 Protected Area coverage in the different Bio-geographic Provinces in the Himalaya

Province	Area of Province (km^2)	State	Name of PA	Area of PA (km^2)	Total Area of PAs (km^2)	% Coverage of PA Area	No. of Species
1A	109754	Jammu & Kashmir	Hemis NP	4100	9775	8.91	4
			Karakoram WS	5000			
		Himachal Pradesh	Pin Valley NP	675			
1B	75069	Jammu & Kashmir	Changthang WS	4000	5443	7.25	4
		Himachal Pradesh	Kibber WS	1400			
		Sikkim	Shingba Rhododendron WS	43			
2A	69401	Jammu & Kashmir	Dachigam NP	141	3419.09	4.93	8
			Gulmarg WS	180			
			Hirapora WS	114.5			
			Kishtwar NP	400			
			Lachipora WS	93.5			
			Overa WS	32			
			Overa-Aru WS	425			
			Limber WS	43.75			
		Himachal Pradesh	Gamgul-Siahbehi WS	108.85			
			Great Himalayan NP	754.4			
			Kalatop-Khajjair WS	61			
			Kanwar WS	54			
			Khokhan WS	14.05			
			Kugti WS	378.86			
			Lippa Asrang WS	30.89			
			Rupi Bhaba WS	269			
			Sechu Tuan Nala WS	102.95			
			Tundah WS	64.22			
			Tirthan WS	61.12			
			Sainj WS	90			

2B	52072	Himachal Pradesh	Chail WS	108.54	6028.48	11.58	6
			Churdhar WS	56.15			
			Daranghati WS	167			
			Darlaghat WS	140			
			Majathal WS	40			
			Sangla WS	650			
			Shimla Water Catchment WS	10.25			
			Talra WS	26			
		Uttaranchal	Askot Musk Deer WS	599.93			
			Binsar WS	45.59			
			Gangotri NP	1552			
			Govind NP	472.08			
			Govind Pashu Vihar WS	481			
			Kedarnath WS	957			
			Nanda Devi NP*	624.62			
			Valley of Flowers NP	87.5			
			Mussoorie WS	10.82			
2C	5457	Sikkim	Maenam WS	35.34	2071.82	37.97	6
			Khangchendzonga NP*	1784			
			Kyongnosla Alpine WS	31			
			Barsey Rhododendron WS	104			
		West Bengal	Senchal WS	38.88			
			Singalila WS	78.6			
2D	83743	Arunachal Pradesh	D'Ering WS	190	10700.57	12.78	5
			Dibang WS	4149			
			Eagle Nest WS	217			
			Itanagar WS	140.3			
			Kamlang WS	783			
			Mehao WS	281.5			
			Lado WS (proposed)	500			
			Mouling NP	483			

			Namdapha NP	1807.82			
			Pakhui WS	861.95			
			Palin WS (proposed)	250			
			Sessa Orchid WS	100			
			Tale Valley WS	337			
			Tawang NP/WS (proposed)	300			
			Walong WS (proposed)	300			
7A	12543	Uttaranchal	Rajaji NP	820	1642	13.1	1
			Corbett NP	520.82			
			Sonanadi WS	301.18			
9B	105050	Manipur	Yangoupokpi-Lokchao WS	184.8	1249.69	1.19	2
		Meghalaya	Balphakram NP	220			
			Nokrek Ridge WS	47.48			
		Mizoram	Dampa WS	500			
			Murlen NP	200			
			Khawnglung WS	41			
			Phawngpui WS	50			
		Nagaland	Fakim WS	6.41			

**Some portions of these PAs fall in Zone 1B Also.*

Table 3: Sizes of Protected Area in different Biogeographic Zones

Biogeographic Zone	Biogeographic Province	No. of PAs	Minimum size (km^2)	Maximum size (km^2)
1	1A	3	675	5000
	1B	3	43	4000
2	2A	20	30.89	754
	2B	17	26	1552
	2C	6	31	1784
	2D	15	100	4149
7	7A	3	301.18	820
9	9B	8	6.41	500

Chapter 4

Mountain Ungulates of Ladakh, Jammu & Kashmir

Saleem-Ul-Haq

Ladakh – 'the Land of Passes' (*La*-passes, *dakh*-land) is the largest in area when compared to the three main regions of the Jammu & Kashmir State viz., Jammu, Kashmir and Ladakh. This region falls under the districts of Ladakh and Kargil. The most striking feature of Ladakh region is the mountain ranges that stretch from the southeast to the northeast. Although most of Ladakh is mountainous, there are many valleys lying in the lap of the mountain ranges such as the Great Himalayan range, the Zanskar range, the Ladakh range and the Karakoram Range. As like all other high altitude mountainous region, Ladakh is sparsely populated (*ca.* 1,50,000) i.e., only two persons/km^2. Although life is difficult at high altitudes (2,900-5,900 metres), yet both man and wildlife survive here comfortably as revealed by the rich diversity of wildlife.

The Ladakh landscape is characterized by snow-clad mountains, treeless arctic deserts and a few narrow fertile valleys, some of them breathtakingly beautiful. With the advent of summer, a miraculous change occurs when life-sustaining vegetation lends color to an otherwise bleak landscape. Ladakh is a large barren but beautiful region of intense sunlight and clear unpolluted air. The temperature in summer may rise up to 37^{o}C, but may also drop to -40^{o}C degrees in winter. Dras in Kargil district experiences the lowest winter temperatures. There is very low rainfall in the region is about 92 mm/ annum because it is situated in the rain shadow region of the Greater Himalayas. Most of the water source is the frozen snow or ice.

Fauna of Ladakh

The Fauna of Ladakh is a mixture of Palearctic and Oriented regions and comprises mostly of mammals and birds. Ladakh has poor representation of reptiles and amphibians. The mammalian fauna comprises mainly of ungulates, rodents and carnivores. Ladakh is well recognized for its mountain ungulate diversity. Information on the status and distribution of these mountain ungulates in Ladakh are presented below.

Wild Yak: The most notable animal of the Ladakh, Tibet and adjacent parts of central Asia is the Wild Yak. It is a large animal weighting about a ton. It has long black hair, which is tinged with gray at the muzzle. The horns are curved and long which may grow up to 75 cm in length. The wild yak, which moves in herds, spends the summer at great heights and descends to lower altitudes in winter. Prior to 1962, the Wild Yak was distributed in plang darpo and kuenlum into Tibet westwards in Ladakh. As per the local people, the animals were found near Pangong Lake, Changchenmo Valley, Tsoogsalu, Daulat Beg Olde and Chushul areas. Since then, their distribution range has drastically shrunken and number has greatly declined due to massive hunting. There were no official reports on the presence of Wild Yak in Ladakh for the last thirty years. A survey was conducted

by a team of six members in the Karakoram Range of (a corridor between India & China) Changchenmo Valley, North-East of Ladakh during July-August 1996 in order to confirm the presence of Wild Yak. About 300 km were covered during surveys of which 170 km were by vehicle and the rest on foot. One male was sighted at Satlung Yogma and herd of 47 Yaks were sighted at Satlung Parma area in the Karakoram range, Changchenmo Valley. This survey confirmed the presence of Wild Yak in this area.

Tibetan antelope: The *Chiru* or Tibetan antelope (Tsoros-Ladakhi) - is a valuable species that inhabits high altitudes of Ladakh. It is slender but stout looking due to the thick coat of interwoven pale-brown hair. The color varies from season to season and from individual to individual. They roam the eastern fringe of Ladakh and inhabit Aksaichin and Tibetan plateau above 5,000 metres. Their horns measure up to 70 cm and are black having knots indicating the animal's age. In case of male front legs has a strip of black or dark brownish in colour The *Chiru* is persecuted in large numbers for the sake of under fleece-shahtoosh- from which the famous shahtoosh shawls or 'ring shawls' are made. Hardly a pound of under fleece is obtained from one animal. These shawls are the highly priced, softest and warmest quality product.

It was reported that the Tibetan antelope was extinct as no reports of sightings were made during the period 1960-1990. In 1984, the *Chiru* were reported to occur in the Aksai chin and Tibetan plateau. The *Chiru* are migratory and come in to Indian Territory in the Changchenmo valley and DBO during summer. In 1991, the Indian Army reported the presence of *Chiru* in DBO (Daulat Beg Olde) falling in the Karakoram Wildlife Sanctuary located along the border with China. In 1994, Mr. N.A. Kitchloo, Wildlife Warden, Leh, deputed a survey team of 9 person headed by Mr. Amchuk, R.O. to DBO and reported the sighting of *Chiru*. The *Chiru* population was estimated to be between 250 and 300. In India, the *Chiru* is found in the Changchenmo DBO (Daulat Beg Olde) valley of northern Ladakh between 3,700-5,500 metres from where it crosses from Tibet through Lanak la (pass) at the head of the valley. After this survey, it was certain that the animal is not killed in the Indian Territory i.e., DBO and Changchenmo – a fact supplemented by the security forces as well. In Ladakh, the illegal trade was reportedly carried out through the border of Changthang. No trade is reported from DBO and Changchenmo valley where the animals are found at present in Ladakh, the reason being that the area is not inhabited up to at least 180 km from Phobrang village to, Changchenmo and silk head to DBO (Daulat Beg Olde).

The population of *Chiru* has declined drastically by excessive poaching and disturbance of its natural habitats in Tibet as has been reported by various agencies. These animals come into this area during summer season (May to September) and they migrate to the lower elevations across the international border to Winter. They breed there in November – December and the young ones are born in May which is followed by their migration to higher elevations. The *Chiru* is a ruminant and feeds mostly during early mornings and late evenings especially along grassy edges and glacial streams. During day, it spends resting and before resting it first digs or scraps shallow pit in sand/ gravel and lies in side for concealment.

Tibetan Argali: Another pride of Ladakh is *Nayan* or Tibetan Argali found at a height of about 4,500m. A male may weigh up to a quintal. Lt. General Moti Dar has reported their number to be around 200 in eastern Ladakh.

Ladakh Urial: A close relative of *Nayan* is *Shapo* or Ladakh Urial. It is smaller than Nayan a large one weighing around 80 kg. It prefers heights between 3,000 to 4,000 m.

Blue sheep: The *bharal* or Blue sheep is a strange looking creature, half-sheep and half-goat. It differs from the goat in that it doesn't have a beard. Likewise it differs from the sheep in the complete absence of glands on the face. The Bharal are found at an altitude of 6,000 metres. In summer, they graze in large herds on rich and abundant grass of the meadows.

Asiatic ibex: The Asiatic Ibex is the most beautiful of all mountain goats. It supports two long scimitar-shaped horns marked with bold transverse knots on the front surface. They may be over a metre long. The mature males have a long beard and weigh over a quintal. They move in herds of 10 to 16 and prefer precipitous rocks and cliffs. In winter, they descend to the lower altitudes for food and shelter.

Tibetan Gazelle and Tibetan Wild Ass: The Tibetan Gazelle (Goa) is a small mountain ungulate that is distributed in eastern Ladakh. The Tibetan wild ass (Kiang) is a relative of the wild ass of the Rann of Kutch. It has a wide distribution. Besides Ladakh it is found in Tibet, Turkistan and Mongolia. Kiang is shy but an inquisitive animal. It inhabits plain and rocky grounds and can gallop at a good speed. Solitary, animals or groups of 10-12 animals can be seen. The coloring of the upper portion of the body is chestnut or red and the under parts are white. There is a dark brown dorsal stripe extended from the stiff black mane to the tuft of the tail.

Other Herbivores

Among the other herbivores of Ladakh are the Himalayan mouse hare, Tibetan woolly hare, marmot and many other rodents. Marmots are common rodents found above the tree line. They live in burrows and produce shrill ringing calls. They hibernate during winter. Marmots and the hares form important prey base for snow leopard, lynx, fox and large birds of prey.

Conservation Issues

Despite the extremely harsh environment and sparse vegetation, wildlife in Ladakh thrived well prior to India's independence. This was mainly due to the Buddhist philosophy of non-violence. Construction of roads for defence purposes and development of the region ironically provided greater opportunities for killing the wildlife. The defence personnel also had a share in the killings because of their occasional indulgence in Shikar, a legacy of the Raj days. In short, the opening up of Ladakh to the rest of the world has exposed its Wildlife. Skins of the Snow Leopard and under fleece of Tibetan antelope and gazelle fetch fabulous prices, which has rendered wildlife vulnerable to poaching.

Chapter 5

Status and Distribution of some Caprids in Himachal Pradesh

S. Pandey

Introduction

The mountainous state of Himachal Pradesh, with elevations ranging from 300 to over 6000 m, accounts 17% of the area of the north-western Himalayas. Bio-geographically the state can be divided into four distinct regions: the Trans-Himalaya (Biotic provinces 1A & 1B), which include the cold deserts of northern Lahul and Spiti districts; the Greater Himalayas ((Biotic provinces 2A & 2B), high and middle mountains covering most of the state; and the semi Arid zone (Biotic province 4A), consisting the hot dry foot hills in the south (Rodgers *et al.* 2000). The biotic provinces 1A (Ladkah mountains) and 1B (Tibetan Plateau) have mammals of international conservation significance such as the Snow leopard, Tibetan argali and Tibetan gazelle. The biotic provinces 2A (North-west Himalaya) and 2B (Western Himalaya) also have species of international conservation significance such as the Hangul or Kashmir stag and pheasants such as the Wesern Tragopan and Cheer (Rodgers & Panwar 1988). Two National Parks and 32 Wildlife Sanctuaries have been set up so far in Himachal Pradesh covering 10.37% of the state area with proposals for new PAs that would add another 1.08% coverage (Rodgers *et al.* 2000).

Himachal Pradesh has a rich assemblage of over 74 species of mammals (excluding Chiropterans) belonging to eight Orders and 21 Families / Sub Families. Of these, 17 species are unconfirmed although they are most likely to occur in this state. Seven species of caprids are reported to occur in Himachal Pradesh. They are: Tibetan Argali (*Ovis ammon*), Bharal or Blue Sheep (*Pseudois nayaur*), Asiatic ibex (*Capra ibex*), Himalayan tahr (*Hemitraghus jemlahicus*), Serow (*Nemorhaedus sumatraensis*) and Goral (*Nemorhaedus goral*). Himalayan Musk deer (*Moschus chrysogaster*), and Tibetan Gazelle (*Procapra piticaudata*), are the other mountain ungulates that are present in this statea. The Hangul or Kashmir Stag (*Cervus elaphus hanglu*) was reported to occur in the northern parts of this state (Chamba district), particularly in the forested areas (2,500 –3,200m) in and around the Gamgul-Siahbehi WS. There are no recent reports of this species in this state in the recent past. Based on the results of the Wildlife Surveys conducted in Sutlej and Beas catchments, the information on some caprid species in Himachal Pradesh is given below.

Goral (*Nemorhaedus goral*)

In Sutlej and Beas river catchments, Goral is very common. During a wildlife abundance estimation exercise in February 1990, I estimated a density of 1.2 goral/km^2 in Daranghati Wildlife Sanctuary. An estimate of 1.47 goral/km^2 was obtained for Rupi Bhaba Wildlife Sanctuary in Kinnaur district. Goral has been reported from Sangla Valley Wildlife Sanctuary and short of Lippa Asrang

Wildlife Sanctuary, both in Kinnaur district of Himachal Pradesh.

A good population of goral exists in the proposed Rupi Bhaba Wildlife Sanctuary in Shimla and Kinnaur districts. In Kanawar Wildlife Sanctuary, 18 gorals were sighted in a 2 km^2 area during December 1989 wildlife survey. During March 2002, 48 gorals were counted in a day's walk in Rolla-Nara area (immediately after snow fall).

Serow (*Nemorhaedus sumatraensis*)

Serow is fairly common in Sutlej and Beas Catchments. Wildlife survey party could sight one animal in Rashi Thach of Daranghati Wildlife Sanctuary in February 1990. In Rupi Bhaba Wildlife Sanctuary (Kinnaur district), six animals were sighted in different nallahs and evidences for another three animals were recorded during the period, March 1989 to January 1990. Only one fourth of this sanctuary may be considered to be Serow habitat. The area around Srikhand peak is reported to hold good Serow populations. In Kullu district, Serow has been reported in Jiwa Nal and Sainj Nal catchments, and Nalchi forest of Parbati river catchment. Serow has been reported to occur in high abundance in Kalatop-Khajiar Wildlife Sanctuary in Chamba district.

Bharal (*Pseudois Nayaur*)

This species has wider distribution than any other member of Caprinae in the catchment of Sutlej and Beas rivers. The upper reaches of Kinnaur, Lahaul and Spiti and Kullu districts hold good Bharal populations. In a wildlife survey (last week of June, 1990), three groups of Bharal (of 7,5 and 4 individual respectively) were sighted about 4,000 metres on the extension of Hansbesin Massif which forms eastern boundary of Shimla and Kinnaur districts. During various wildlife surveys (1987-90), Bharal has been recorded from both the banks of Sutlej river in Kinnaur district. All the three Wildlife Sanctuaries of Kinnaur, namely Rupi Bhaba, Sangla Valley and Lippa Asrang have good Bharal populations. In April, 1989, the wildlife survey party sighted 26 Bharal and 11 Ibex sharing same hillock in Lippa Asrang Sanctuary. The areas below Pandoswar Peak in Rupi Bhaba Wildlife Sanctuary and the adjoining areas of this sanctuary with Pin Valley National Park and Great Himalayan National Park have good Bharal populations. The newly created Sangla Valley Sanctuary (which includes the earlier Rakcham Chitkhul Sanctuary) has forested as well as arid areas (Transition zone). The eastern part of this sanctuary (close to Indo-Tibet Border) has Bharal populations. In addition to these, Ropa Valley, Pooh, Rishi Dogri, Neshang, Nako and Sumdo are places in Kinnaur district where Bharal sightings have been made during 1988-90. It has also been sighted along the Shrikhand Dhar in the Rupi Bhaba Wildlife Sanctuary.

Bharal is principal species of left bank of Spiti river, though it has been sighted in good numbers on the right bank, too. During last week of November, 1989, the density of Bharal was estimated by the King's Method. A total of 28 Bharal were sighted on a stretch of 14 Kms road length, thus resulting in a density of 2 Bharal/km^2. This density increases dramatically, immediately after the snowfall when Bharal move down into the valley bottom. In Pin Valley National Park, bharal have been sighted in very low numbers. Only one Bharal was seen with a group of 25 male Ibex above Mud village during August, 1988. I could see a six feet high cairn made up of Bharal horns in

November, 1989 near Tabo village in Spiti Valley. The local Buddhist people collect these horns to ward off the evil spirits.

There are positive reports of Bharal from the higher reaches of the Great Himalayan National Park in Kullu district. In October, 2001, a group of more than 45 bharals were sighted at Sartoo glacial lake in Jiwa-Nal valley of this Park (Pandey, pers. Observations). Regular sightings of bharal are reported from the Tirath area in the Tirthan valley. In Parbati river catchment. Bharal have been reported from above Tos Nal Forest on right bank and Tebla Thatch on left bank. In Lahaul, Bharal have been reported from near Bara Lach Pass.

Himalayan Tahr (*Hemitrangus jamlahicus*)

In Sutlej Valley, the Himalayan tahr has been sighted in Daranghati, Sangla Valley and Rupi Bhaba Wildlife Sanctuaries. A wildlife abundance estimation exercise conducted in Daranghati Part-II during January 1990 resulted in a density estimate of 2.26 tahr/ km^2. The largest group size recorded was of 4 animals only. Its status in extended Rupi Bhaba sanctuary on the right bank of Sutlej river is quite good. However, its sightings, at present have become progressively less towards Rupi Bhaba and Sangla Valley Wildlife Sanctuaries beyond which arid zone areas of Kinnaur district start. The Kullu district in Beas catchment has good Himalayan Tahr population. During a wildlife survey in December 1989, in Kanawar Wildlife Sanctuary, a total of 130 Himalayan Tahr were seen in a 2 km^2 area. The largest group size of Himalayan Tahr was of 25 individuals. This trend continues upto the Great Himalayan National Park though the habitat is quite fragmented in between the two PAs. During October 2000 surveys, 17 Himalayan Tahr were seen in one group along the dividing ridge between Sainj and Tirthan catchments.

Siberian Ibex (*Capra ibex sibericus*)

During 1987-90 wildlife surveys, Ibex was seen on the right bank of Sutlej river only. This fact confirms the statement of Prater (1971) that its eastern limits are set by the upper reaches of the Sutlej river, east of which it does not occur. However, a lager number of Ibex horns could be seen as offering to the temples in the Sangla valley which is in east of Sutlej river (*i.e.* on the left bank of the river) in Kinnaur district of Himachal Pradesh. No ibex was sighted on the left bank. It appears that the horns were collected and transported from the right bank of the river.

In Kinnaur district, Ibex were sighted in Lippa Asrang Wildlife Sanctuary in April 1989 (11 Ibex and 26 Bharal on the same aspect). The reported occurrence of Bharal in Rupi Bhaba and Dharangati Wildlife Sanctuaries is incorrect. The Pin Valley National Park is a stronghold of Ibex. In November 1989, a total of 174 animals were seen in about 76 km^2 which indicates an estimated density of 2.29 Ibex/km^2. Ibex is found on both the banks of Spiti river above Kaza. The areas of Ratang Valley near Losar and Kunzam Pass have good Ibex populations. Evidences of Ibex have been obtained from Chandra and Penglang valleys. Recently, sightings of Ibex have been made in Manali Wildlife Sanctuary, Hamta Nala and Solang Nala in Kullu district. Its presence/absence is yet to be confirmed from the Great Himalayan National Park.

Nayan or Tibetan Argali (*Ovis ammon)*

The only confirmed place from where horns of Argali could be obtained is in Kibber Nala (Spiti Valley). The villagers

told that at times Nayan cross over to Himachal area from the adjoining Jammu & Kashmir state. The usual route is along Parang La. Only a few individuals come (one or two or three) along with local sheep and goat. I have no other evidence of the presence of this species from Himachal Pradesh.

Astor or Straight-horned Markhor (*Capra falconeri*)

There is no confirmed evidence or sighting of Markhor from the Chenab river catchment in Himachal Pradesh.

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Chapter 6

Status, Distribution and Management of Mountain Ungulates in Uttaranchal

A.S.Negi

1. Introduction

Uttaranchal is very rich in Biodiversity and is represented by Biogeographic Zones 2B Western Himalaya and 7B Siwaliks in this region. The uniqueness of ecological diversity from high alpine areas to the Terai region interspersed with numerous rivers is unparalleled. Different forest types can be identified in the state that spreads over 34,661 Km^2. The Forest Department controls about 23,988 Km^2 (64.81%). About 18.7% of the total area under the Forest Department has been clearly earmarked for Biodiversity conservation by the creation and management of 12 Protected Areas (PA) in the state. These PAs are:

National Parks (NP):

Sl N0	Name of the PA	Year of Establishment	Area (Km^2)	District(s)
1.	Corbett NP	1936	521	Garhwal
2.	Nanda Devi NP	1982	630	Chamoli
3.	Valley of Flowers NP	1982	87	Chamoli
4.	Rajaji NP	1983	820	Dehradun & Haridwar
5.	Gangotri NP	1989	2,390	Uttarkasi
6.	Govind NP	1990	472	Uttarkasi

Wildlife Sanctuaries (WLS):

SIN o	Name of the PA	Year of Establishment	Area (Km2)	District
1.	Govind WLS	1955	521	Uttarkasi
2.	Kedarnath WLS	1972	957	Chamoli
3.	Askot WLS	1986	600	Pithoragarh
4.	Sonanadi WLS	1987	301	Garhwal
5.	Binsar WLS	1988	46	Almora
6.	Musoorie WLS	1993	11	Dehradun

The mammalian diversity in Uttaranchal is one of the richest in the country, exceeding 75 species; about 50% of these are threatened. A detailed analysis of the data shows that 37.8% of species fall under lower risk least concern category and 19.51% under lower risk not threatened status. The critically endangered species constitute 6.09%, while vulnerable species account for 12.91%.

The Mountain ungulates are quite varied in Uttaranchal. They are mostly distributed in Seven Protected Areas located in the Western Himalyas *viz.*, Gangotri NP, Govind WLS and Govind NP, Kedarnath WLS, Nanda Devi NP, Valley of Flowers NP, Binsar WLS and Askot WLS. The species include Himalayan Musk Deer (*Moschus chrysogaster*) Himalayan, Tahr (*Hemitragus jemlahicus*), Blue Sheep (*Pseudois nayur*), Serow (*Nemorhaedus sumatrensis*) and Goral (Nemorhaedus goral). Sambar (*Cervus unicolor*) and Barking Deer (*Muntiacus muntjac*) also occur in the region, generally below 2,700m.

2. Status & Distribution:

The distribution and status of mountain ungulates in Uttaranchal in different PAs are as under (as per the record contained in the management plans of the PAs and information collected from the field).

Name of the Protected area	Name of the species	Status		
		Rare	Common	Abundant
Gangotri NP	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Barking deer 6. Blue sheep	? 	? ? ? ? 	 ?
Kedarnath WLS	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Barking deer 6. Blue sheep *	? 	? ? ? 	 ?
Nanda Devi NP	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Blue sheep	? ?	 	? ? ?
Govind WLS and Govind NP	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Blue sheep	? 	? ? ?	 ?
Valley of Flowers NP	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Blue sheep	 ? ? ? ?	? 	
Binsar WLS	1. Tahr 2. Serow 3. Goral 4. Musk deer 5. Barking deer 6. Blue sheep	? ? ? ?	 ? ? 	

** Status unknow*

The following areas of Uttaranchal are mainly known to have Musk deer. However, these areas are only representative areas and further research and surveys are required to know the site specific locations and number of animals present in these areas.

In a survey conducted in 1968-72 the following estimates were made for some of the Musk Deer rich areas of Uttaranchal on the basis of field reports.

1. Almora Kapkot *Between 20 and 30*
2. Pithoragarh Dharchula *Between 25 and 40*
3. Tihri Garhwal Bhilangana *Between 25 and 40*
4. Uttarkasi - Purola & Naogaon *Between 24 and 36*
5. Chamoli - Raksi *Between 15 and 30*
6. Ukhimath *Between 10 and 15*
7. Tahrali *Between 10 and 15*

This survey was conducted many years ago. However on the basis of sightings and on the basis of frequency of sightings the number of three species have been steadily growing. These are Goral , Blue sheep and Tahr . The numbers of Barking deer is also on the rise. True status of Musk deer is still not very clear. However their number in the strictly protected areas like Nanda Devi NP has definitely taken an upward trend.

3. Management issues:

3.1 Main issues:

- Large scale killing of mountain ungulates in the past century specially musk deer, Tahr and Blue sheep.

- In winter the snow line drops. This is also the time of rutting. Some mountain ungulates migrate down to lower reaches and this provides an easy opportunity for the poachers to kill the animal.
- Degradation of habitat due to increase in biotic pressure.
- Lack of funds and infrastructure.
- Lack of intra state and inter state communication between the PAs and well chalked out conservation plan.
- Lack of special high altitude training and working facilities for the staff.
- Captive bred animals are not being utilized for optimum use.

3.2 On going measures.

Creation of Protected areas

Seven protected areas *viz.*, Gangotri NP, Nanda Devi NP, Govind NP, Valley of Flowers NP, Kedarnath WLS , Askot WLS and Govind Pashu Vihar WLS have been created and special protection measures are being undertaken for the conservation of all the ungulates along with the associated flora and fauna in Uttaranchal. Eco-development programmes are being taken up for better management of buffer zones so that local activities, such as livestock grazing, agriculture and the collection of forest produce, are contained within certain areas, while others, including representative patches of habitats of endangered ungulates such as the musk deer, are left undisturbed as "strict natural" or "wilderness" areas.

Preparation of landscape Management plans.

Landscape management plans for all the seven PAs are being prepared taking into account all the areas near the PAs and the concerned stakeholders who have a bearing on conservation to facilitate better understanding and better awareness among all concerned parties.

Ex situ Conservation Management in Uttaranchal.

In Uttaranchal, two Himalayan Musk deer Breeding Centres viz., Kanchula Kharakh (Chamoli) and Dharmaghar (Almora) have been created and managed. A few mountain ungulate species along with other high altitude fauna are housed and managed in the Naini Tal Zoo.

The status of these breeding centres are as follows:

Name of the Centre	Date of Establishment	Admn. Authority	Area	Elevation	Temp Rang	Number Animals
Musk Deer Research Centre, Almora	1971	Central Council for Research in Ayurveda & Siddha	2 Acre	7,500 ft.	Max - 31 C Min- Below freezing	13.15.0 [mm.ff.yy]
Kanchula Kharakh Chamoli	1982	Forest Department	20 Ha.	9000 ft.	Max - 31 C Min- Below freezing	9.6.0

3.3 The Challenges & the Conservation strategy:

Most PAs of Uttaranchal lack the financial and manpower resources to adequately protect the mountain ungulates and it's apex predator snow leopard and/or Common leopard. Additional constraints include extremely remote and rugged range, harsh climatic and environmental conditions that prevail in many areas, the long international borders that are accordingly difficult to patrol, and a severe lack of trained and motivated staff to conduct surveys, logistic and

infrastructural support and management plans.

A large number of wild animals, including Musk deer, are found outside existing PAs. According to an estimate, 80% of wild animals may venture outside the PAs. Presence of animals such as the Blue Sheep, Serow, Black Bear, Musk deer, Goral occurring outside the PAs is quite common. Presence of wild animals particularly in the periphery is not only due to lack of prey animals and foraging site inside the park but due to sharp edge effects created by the villagers. Effective monitoring of ungulate populations outside PAs and proper documentation of every case of animal lifting, human loss or poaching will also help reduce the conflict with park managers

Bulk of the people of the region depend on cattle rearing. The potential impacts of excessive grazing by livestock include depletion of the scarce forage for wildlife, habitat degradation and disease transfer.

Abundance or population estimation of high altitude ungulates is a specialized job and it cannot be done in a routine way. Not only specialized equipments like light and powerful field glasses and cameras are required, but also involvement of technical staff and researchers is a must. For proper maintenance of records and analysis of field data Computers and Statistical software are also required.

General perception of the local people about endangered species and their importance in the ecosystem is poor. Efforts are needed to highlight biological and morphological importance of the PA in the context of human existence. Education camps and special trainings for the local N.G.Os, youth club members, Mahila Mangal Dal (Womens' Group) members will have to be provided. In addition to these, capacity of the local staff will also have to be developed to arrange grass root training camps on their own.

The mountain ungulates of Uttaranchal not only hold a great ecological value but they are also part and parcel of cultural ethos and heritage of this Himalayan state. All concerted efforts are being made to save them for posterity and for the healthy sustainable ecological balance. Challenges are many but the Wildlife wing of the Forest Department of Uttaranchal is all set to successfully handle these challenges.

Chapter 7

Status, Distribution and Management of Mountain Ungulates in Sikkim

T. R. Sharma & U. Lachungpa

1. Introduction

One of the smallest states in India, Sikkim lies between 27°5' to 28°9' N and 87°59' to 88°56' E, covering an area of 7,096 km^2, extending approximately 114 km north-south and 64 km east-west. Wedged in between the Himalayan kingdoms of Nepal in the west and Bhutan in the east, Sikkim is bounded by Darjeeling District of West Bengal in the south and a stretch of Tibetan Plateau in the north. In this land of vast altitude variation (*ca.* 300m – 8,586m) within very short distances, elevation has played a major role in fashioning the various eco-regions. This is evident from the presence of the sub-tropical Rangit Valley Sal forests with Wild boar and Indian muntjac in the south, to the temperate fir forests harbouring Himalayan tahr and Musk deer in the north, beyond which lie the Trans-Himalayas and cold desert of the Tibetan plateau supporting Kiang and Nayan. Sikkim is classified as part of the biogeographic province 2C (Central Himalayas), which in India includes the Darjeeling district of West Bengal with Temperate-Broadleaf biome, with the north of Sikkim as biogeographic province 1B (Trans-Himalayas-Tibetan plateau) with biota of Palaearctic affinity. The latter area is high-altitude cold desert in the rain-shadow of the main Himalayan range with typically Tibetan flora and fauna.

As per the 2002 Annual Administrative Report of the Department, about 2,177 km^2 or 30.68 % of the total geographical area of the state is under wildlife protection, which is perhaps the highest in the country. The largest Protected Area (PA) in the state, the Khangchendzonga Biosphere Reserve was notified in February 2000. It is spread over North and West districts encompassing 1,784 km^2 of Khangchendzonga National Park (KNP) and 835.9 km^2 over four buffer zones totaling an area of 2,619.9 km^2. These buffer zones are Lhonak Valley, West Chungthang-Lachen, Tholung Valley and Rangit and Tista Catchments. Pangolakha Wildlife Sanctuary was recently declared on the Bhutan – China (Tibet) – India (Sikkim and West Bengal) tri-junction. There is also another proposal for declaration of a cold desert protected area in north Sikkim (Fig. 1).

2. Mountain Ungulate Surveys in Sikkim

Over the last three decades, the State Forest Department conducted sporadic management surveys of which no detailed records were kept. Some such patrols were anti-poaching or 'Operation Trap Demolition' expeditions in the Khangchendzonga National Park (KNP) to dismantle vast stretches of live rhododendron shrubs worked for kilometres into traps for Musk deer. In a

1993 Tiger Census in north and east Sikkim, other species of wildlife encountered including ungulates, were also recorded. The following areas were specifically covered in KNP (Lachungpa, C. *pers. comm.*):

i. Yuksom – Dzongri – Goecha La, Lampokhari trekking trail (W)

ii. Tholung Valley (N)

iii. Chungthang-Menshithang-Bikmatar, Phimphu (N)

iv. Lachen-Zema-Green Lake (N)

v. Thangu-Muguthang-Green Lake (N)

In the last decades, two surveys were conducted specifically for mountain ungulates in Sikkim. Between 1995-1997, Mr. C. Lachungpa, Divisional Forest Officer, with assistance from WWF-India surveyed the Pangolkha range for the *Shou* or Sikkim stag. The areas covered included Rachela, Phadamchen, Rigyap, Menmoitso and Menla. No *shou* was recorded (Lachungpa, C. *pers. comm.*) but there was one indistinct sighting of the Takin. It was based on this survey that the proposal for declaration of the area as Pangolakha National Park was moved and in 2002 the Pangolakha Wildlife Sanctuary was declared. In 1996, Mr. C. Lachungpa as the first Kailash Sankhala Awardee, initiated another survey for the Himalayan Tahr locally called '*Shapi*', in the KNP. He confirmed the existence of the species not only in the Phimphu area in north KNP but also in the western part of the park. (Lachungpa, C. *pers. comm.*). Much earlier around 1986-87, a group of foreign trekkers had reported sighting of the Tibetan argali in west KNP above Goecha La, (report not traceable) in a note to the Department but their observations could not be confirmed. In 1988, Mr. S. Z. Lucksom as Field Director (KNP) was the first to film the Shapi in Sikkim from the Phimphu area.

Opportunistic sightings of mountain ungulates were also recorded during the following departmental research surveys between 1988-2002. Information from these was used in relevant short publications, papers presented during seminars or as short unpublished departmental reports. Tables 3, 4 and 5 are based on these as well as the above.

- Asian Waterfowl Counts in the Trans-Himalayan and alpine regions of north and east Sikkim, 1988-1994
- Short surveys for butterflies in all four districts, 1988 -1994 (information used in Haribal, M. 1992)
- Cold desert wildlife surveys in north Sikkim 1988, 1991-1995
- Survey of birds of Fambong Lho Wildlife Sanctuary, east Sikkim, 1989
- Wildlife expedition to Lhonak Valley-Green Lake, north Sikkim, 1990
- Wildlife survey of Lhonak Valley, Lashar Valley and Tso Lhamo Plateau, north Sikkim, 1992
- Wildlife survey including bird ringing studies at Lashar-Sebu La-Yumesamdong-Tembawa and Dongkia La-Tso Lhamo Plateau, 1995
- Royal Botanic Garden Edinburgh expedition to Lashar-Sebu La-Yumesamdong-Tembawa and Lachung Valley, north Sikkim, Fambong Lho Wildlife Sanctuary (WLS), east Sikkim, July 1996
- Oriental Bird Club bird survey in Kitam and lowland forests, south Sikkim and Barsey Rhododendron Sanctuary, west Sikkim, Mar-Apr and Sep-Oct 1996

- Biodiversity survey of Maenam Wildlife Sanctuary, south Sikkim, in collaboration with the World Pheasant Association in April-May 1998
- Red Panda pilot survey for the WWF in and around PAs, Sep-Dec 1998
- Bird ringing studies in Fambong Lho WLS, Kyongnosla Alpine Sanctuary, Himalayan Zoological Park, east Sikkim, 1992-93, 1995-96, 2000
- Alpine Grassland Ecology Project of BNHS in sub-alpine, alpine and Trans-Himalayan areas of north Sikkim, 2000-2002, study sites being Tso Lhamo plateau, Thangu, Lhonak and Lashar valleys, Yumesamdong, Yumthang

As many as 15 species of wild mountain ungulates were recorded from this small portion of the Himalayas, ranging from the Tibetan Wild Ass *Equus kiang* and the (Globally Threatened) Nayan or Great Tibetan Sheep *Ovis ammon hodgsoni* on the Tibetan Plateau, to the Indian Muntjac *Muntiacus muntjac* and Wild Boar *Sus scrofa* in the sub-tropical south. So far the State Forest Department has not recorded some species such as the Mouse-Deer, Pygmy Hog and Hog Deer reported in literature from 'Sikkim Terai', area which is no longer within the present limits of the state. Some Chital *Axis axis* from the Rustomjee Deer Park, Gangtok, were released into the lowland forests in the last decade and are still occasionally sighted. Interestingly, single individuals of two other ungulates, Takin and Gaur were sighted as recently as 1999 and 2002 from Kyongnosla Alpine Sanctuary and the recently declared Pangolakha Wildlife Sanctuary both in east Sikkim (Departmental Report, *in prep.*). While the lone Takin was a novelty for most of the local people, the Gaur was found to be commonly called '*Mithun-Gai*'. Both

Table 1A: Legally Gazetted Wildlife Protected Areas in Sikkim

Name of the PA	District	Area in km^2	Date of Notification
National Park			
1. Khangchendzonga National Park	North and West	1,784	26.08.1977
Wildlife Sanctuaries			
1. Shingba Rhododendron Sanctuary	North	43	05.12.1992
2. Barsey Rhododendron Sanctuary	West	104	08.06.1996
3. Kyongnosla Alpine Sanctuary	East	31	05.12.1992
4. Fambong Lho Wildlife Sanctuary	East	51.76	02.04.1984
5. Maenam Wildlife Sanctuary	South	35.34	09.03.1987
6. Pangolakha Wildlife Sanctuary	East	128	07.11.2002

Table 1B: Proposed PAs

1. Tso Lhamo Cold Desert Conservation Area	North	2.00
2. Kitam Bird Sanctuary	South	6.00
3. Rabdentse Bird Sanctuary	West	2.00

species are now known to occasionally stray over from the Bhutan border.

There are seven PAs in Sikkim (Table 1A), but none so far either in the lowland forests or Trans-Himalayan Sikkim, though Kitam Wildlife Sanctuary for peafowl in the south and a Cold Desert protected area for trans-border ungulates like nayan, kiang and Tibetan gazelle in the north have been proposed (Table 1B). The state also has feral ungulates in some of the PAs.

3. Status and distribution of Mountain Ungulates of Sikkim.

Table 2 summarizes the occurrence of wild ungulate species in different existing PA s of Sikkim. Available information on their status is also given. Information on other ungulate species such as wild boar and chital, that occur outside the mountain zone is also included.

4. Wildlife management in Sikkim

In the biodiversity hotspot that is Sikkim, wildlife management practices are area and not species specific. The present management practices followed are:

1. Habitat oriented management:

   a. Habitat improvement: afforestation of wildlife amenable species using gap plantation in degraded areas and block plantation in forest blanks

   b. Water regime improvement: creation of waterholes, revitalization of existing lakes and ponds

   c. Reducing fire hazards: with help from the Eco Development Committees around PAs

2. Law enforcement: implementation of Wildlife (Protection) Act (1972, 2002), creation of information network with help from Ecodevelopment Committees (EDC), reduction of grazing, liasoning with the Indian Army, Border Roads Organisation

3. Research and Development: field surveys, mapping of PAs using remote sensing & GIS (newly initiated)

4. Survey and demarcation: installation of boundary pillars around PAs

The Department carries out regular patrolling for monitoring of habitat to control wildlife offences inside the PAs. However there is no effective monitoring of ungulate populations outside PAs.

One of the main threats being faced by wildlife (especially mountain ungulates) as perceived by the State Forest Department is lack of awareness, especially in the remote areas. Barking deer, Goral, Serow occasionally fall prey to traps laid for crop protection and their hides were used to make small stools (*mudas*) for domestic use. There have also been instances of discarded wire and metal being used to snare Blue Sheep in restricted areas where road construction and maintenance take priority and temporary settlements of non-native labourers are located. Along the international border where national defence takes priority, Nayan fall prey along with Kiang and Yak to land mines. Also, all wildlife especially ungulates are plagued by the problem of stray and feral dogs near army installations. These and other issues are being addressed in a study presently underway for development of a conservation strategy for the alpine grasslands of Sikkim, in collaboration with the Bombay Natural History Society. The issue has also been addressed in the National Biodiversity Strategy and Action Plan (NBSAP) where a separate SAP has been written for the Indian Army in Sikkim.

Table 2: Occurrence of ungulate species in different PA s of Sikkim. Information based on departmental surveys and records.

[District name given in parenthesis. Status: R = Rare; C = Common; A = Abundant; ? = Occurrence uncertain. PAs: SRS = Shingba Rhododendron Sanctuary (N), KAS = Kyongnosla Alpine Sanctuary (E), FBL = Fambong Lho Wildlife Sanctuary (E), PGL = Pangolakha Wildlife Sanctuary (E), KNP = Khangchendzonga National Park (N & W), BRS = Barsey Rhododendron Sanctuary (W), MNM = Maenam Wildlife Sanctuary (S)]

Species	Wildlife Protected Areas							Outside	
	SRS (N)	KAS (E)	FBL (E)	PGL (E)	KNP (N&W)	BRS (W)	MNM (S)	Lowland Forests (S)	Trans-Himalaya (N)
Equidae									
Equus kiang Tibetan wild ass	-	-	-	-	-	-	-	-	R
Suidae									
Sus scrofa Wild boar	-	-	C	C	C	C	C	A	-
Moschidae									
Moschus chrysogaster Himalayan musk deer	R	R	-	R	R	R	R	-	-
Cervidae									
Axis axis Chital, Axis deer	-	-	-	-	-	-	-	R	-
Cervus elaphus Shou	-	-	-	?	-	-	-	-	-
Cervus unicolor Sambur	-	-	-	R	?	-	?	?	-
Muntiacus muntjac Indian muntjac, Barking deer	-	R	C	C	C	C	C	A	-
Bovidae									
Bos gaurus Gaur, Indian bison	-	-	-	R	-	-	-	-	-
Bos grunniens Domestic yak	C	C	-	R	C	C	-	-	C
Budorcas taxicolor Takin	R	R	-	R	-	-	-	-	-
Procapra picticaudata Tibetan gazelle	-	-	-	-	-	-	-	-	R
Naemorhedus goral Himalayan goral, Common goral	C	C	R	C	C	C	C	R	-
N. sumatraensis Southern serow, Mainland serow	R	R	R	R	C	R	C	R	-
Hemitragus jemlahicus Himalayan tahr	-	-	-	-	R	-	-	-	-
Ovis ammon Nayan Great Tibetan sheep, Argali	-	-	-	-	R	-	-	-	R
Pseudois nayaur Bharal, Blue sheep	C	R	-	R	C	?	-	-	R

With newer areas under the PA network, many more management initiatives are being proposed such as intensive scientific research, strengthening of EDC network, training of forest staff, creation of alternative livelihoods for people dependent on forest resources and preparation of detailed management plans for the PAs.

Mountain ungulates such as Goral and Bharal are also covered under an *ex situ* management programme in the Himalayan Zoological Park at Bulbuley, Gangtok.

There are however many limitations for wildlife conservation in Sikkim, the leading one being those imposed by international border restrictions (Nepal, Tibet and Bhutan), difficult terrain and harsh, high altitudes, followed by lack of awareness, of motivation, of infrastructure and logistics (barracks, range offices, vehicles, ammunition and communication), lack of skilled manpower, lack of research and lack of funds. This severely limits options for patrolling wildlife outside PAs especially in the Trans-Himalayan area of north Sikkim.

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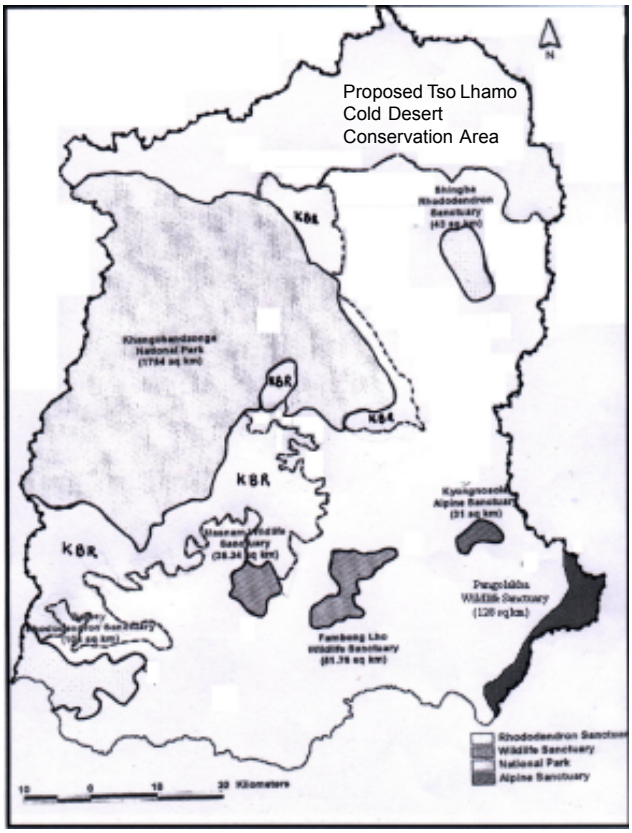

Fig. 1 Protected Areas of Sikkim

Chapter 8

Status and Distribution of Mountain Ungulates in Arunachal Pradesh

D.N.Singh

Introduction

The present Arunachal Pradesh was part of Assam till 1914, and was known as the North - East Frontier Tract till 1954 and as the North East Frontier Agency (NEFA) up to 1972 when it was given its present name. It is situated between 26^0 28' N & 29^0 30' N and 91^0 30' E & 97^0 30' E. It covers a geographical area of 83,743 km^2. It is the largest state in the northeastern part of India. The state is predominantly hilly and mountainous. It is flanked by Tibet to the north separated by the McMohan line, Bhutan to the west, China and Myanmar to the east, and the Indian states of Assam and Nagaland to the south. It is predominantly a tribal state consisting of 82 major tribes and sub–tribes of Indo-Mongoloid and Mongoloid lineage. (Singh,1999). The tribal communities are fully dependent on natural resources for their sustenance and due to sparse population density, 13 persons/km^2 (Anon. 2001) and large tracts of hilly forest, pressures on the forest and wildlife were minimal despite traditional hunting. In recent times, however, this has rapidly changed because of pressure from increasing human population within the state, the market forces from outside the state and large development projects taken up to give a boost to the region's economy to improve the quality of life of its people. Most of the land area of the state is under tribal ownership which is managed under their customary practices.

Physiographically, a major portion of state is divided into two sections, viz., the flood plains of the Brahmaputra and its tributaries, and the Arunachal Himalayas. The Arunachal Himalayas is further sub-divided into three sub-regions - the foothills, the Greater & the Lesser sub-Himalayan Ranges, Siwaliks and Purvanchal (Singh, 1999). The hills of the Naga-Patkai ranges are included in Purvanchal.

The flora and fauna of the state predominantly have Oriental affinities. As per Rodgers and Panwar's (1988) Bio-geographic Classification the state has is classified under the 'Eastern Himalaya - Province 2D (Rodgers *et. al.* 2002). Tirap and parts of Changlang district falling south of Chowkhan Pass and Noa-Dehing (Diyun) river is part of the Naga-Patkai mountain ranges. As such, bio-geographically, this belt of the state should have been included in the North East Hills (9B) Bio-geographic province of the North-East India zone in the classification of Rodgers *et al.* (2002). This state is also bio-geographically important because it falls in the transition zone between Indian subcontinent and Indo-Chinese bio-geographical regions (Dinnersten *et al.* 1997). It is the gateway to India's rich biodiversity and is among the world's 25

global biodiversity hotspots, and identified as being among 200 globally important eco-regions.

The state has a wide altitudinal variation ranging from 300 m in the foothills to about 7000 m along the Greater Himalayan Peaks in the north. The areas having altitudes more than 4,500 m are generally under perpetual snow cover. Arunachal Pradesh falls under the Upper Brahmaputra River System constituted by six river basins namely Kameng, Subansiri, Siang (the Tsangpo in Tibet), Dibang, Lohit – Tellu and Tirap river basins including sub-basins of Tawang, Sessiri and Tiso (Singh, 1999).

In addition to the variations in the climate at the local level due to relief conditions and drainage patterns, the climate of Arunachal Pradesh can be classified into three major types: the hot and humid sub-tropical climate of the South (foothills), cooler temperature zone of Lesser Himalaya, and alpine zone of the Greater Himalaya adjacent to Tibetan plateau.

It is located in one of the heaviest rainfall zones of the country. Due to complex relief features and drainage systems the rainfall pattern in the state is very complex. The annual rainfall is spread over 8-9 months and varies from 1,000 mm in higher reaches to 5,000 mm in the foothills. While it is 4,000 mm in the low land areas of Siang- Lohit valleys, it goes up to 5,000 mm in the lower parts of Siang and Dibang rivers. The Western and North–Western parts of the state receive moderate rainfall ranging from 2,500 mm to 1,000 mm annually. The pre-monsoon showers start from March. The monsoon is active from May to September. The retreating monsoon is active during October and November. The humidity during the rainy season goes up to 90%. (Singh, 1999).

The bulk of the region consists of shales, schist and conglomerates. The soil is acidic in the lower elevations of the valleys due to high rainfall. However, it is rich in humus contents.

The vegetation can be classified in six forest types - five broad types with a distinct sixth secondary forests type, which is largely man made (Anon.,1999). They are:

1. *Tropical Forests*
   - (a) Tropical Evergreen Forests
   - (b) Tropical Semi-evergreen Forests
2. *Sub- Tropical Forests*
3. *Pine Forests*
4. *Temperate Forests*
   - (a) Temperate Broad Leaved Forests
   - (b) Temperate Conifer Forests
5. *Alpine Forests*
6. *Secondary Forests*
   - (a) Degraded Forests
   - (b) Bamboo Forests
   - (c) Grasslands

Its location adjacent to the Tibetan Plateau and the wide variation in climatic and altitudinal conditions offer congenial environments for a wide variety of fauna including mountain ungulates. However, information about their status and the individual species present in the state is poor, because of the remote mountainous habitat and also the lack of requisite infrastructure available with the Forest Department. The research and inventory works carried out by the Forest Department and other agencies active in the field of wildlife conservation is negligible and so, the information available today does not provide the correct picture about the status of

mountain ungulates. Therefore, an attempt has been made to assess the status of the mountain ungulates in Arunachal Pradesh on the basis of the Management Plans / Working Plans, Forest Department publications and records as well as field information and other relevant publications.

Arunachal Pradesh has two National Parks and 11 Wildlife Sanctuaries spread over 9,897 km^2 (11.81% of geographical area of the state) for protection and conservation of its flora and fauna. The state has more PAs in its southern parts covering foothill tropical evergreen forests and mid-elevation subtropical forests. The mountain ungulates are residents of higher altitudes and its habitat is mostly along the Northern parts of the state bordering the Tibetan plateau. It has not been protected adequately under the PA network. There are more mountain ungulate habitats outside the protected areas than inside. Therefore, the status of mountain ungulates outside the protected area should also be looked into. The information about the mountain ungulates in different protected areas is given in Table 1.

Status of Mountain Ungulates outside the Protected Areas:

The ideal habitats of mountain ungulates are the high altitude areas in the northern portion of the state bordering the Tibetan Plateau. The Zoological Survey of India has recorded presence of Serow (*Nemorhaedus sumatraensis*), Red Goral (*Nemorhaedus baileyi*), Mishmi Takin (*Budorcas taxicolor*), Musk Deer (*Moschus chrysogaster*) and Bharal (*Pseudois nayaur*) in the state (Ghosh *et.al*, 1987). The wild Yak (Bos *grunniens*) is found in the higher reaches of the state particularly areas bordering Tibetan plateau (sighted and photographed by the Author). However, the ecological status in the wild is not clear. The Musk Deer is found through out the state in the alpine zone. The local people of the Dibang Valley district have informed the author about the occurrence of two varieties of musk deer. One of them is bigger and is found at lower elevations and has bigger musk pods whereas the other variety is a smaller one and is found at higher elevations but have smaller musk pods. This fact however needs to be substantiated.

For better protection of these high altitude fauna outside the present protected area network, the Wildlife Institute of India has recommended extension of some existing PAs and creation of few new one's (Rodgers and Panwar, 1988). Based on these recommendations the Forest Department has identified some high priority conservation areas, that includes: Zimithang, Jang, Thingbu-Mukto, Taksing, Mechuka, Jorging, Metang, Maibung and Ditchu. These areas do not have much human presence and can be easily taken up for conservation purposes under protected area network.

THREATS

The main threats to the conservation of mountain ungulates in the state are:

1. **Poaching:** The tribal people of the state practice hunting of mountain ungulates for meat, hide and trophies. The traditional conservation ethics amongst local tribal communities, included taboos on hunting of wild animal with younger calves or pregnant females. However, nowadays these taboos are fast eroding. Moreover, due to use of firearms for hunting - instead of bows and arrows,

traps and snares - which were used earlier, hunting intensity has increased. In the high altitudes, the alternatives available for food are limited. Therefore, mountain ungulates are one of the major source of protein for the tribal people. In the past, the low population density of the tribal people compared with large forest area did not pose any immediate threat to wild populations. However, over the years, due to various reasons, the population of the people has gone up thereby increasing the demand and the consequent pressure on the mountain ungulates among others. In the case of the musk deer, it is the high economic value of musk in international markets and lack of other income-generation opportunities for local people which have considerably increased its poaching for musk.

2. **Absence of Forest Personnel**: The northern portion of the state does not have the minimum basic network of Forest Beat and Range Offices for this vast area. Most of these areas do not have any presence of the forest personnel in whatever manner. In the existing few Range and Beat Offices the sanctioned posts of the field personnel are negligible compared to the vast territorial jurisdiction earmarked for that Beat/ Range for protection. The communication facilities are non-existent – no communication sets, no vehicles, no roads. Out of few sanctioned posts, many posts continue to remain vacant for years. The staff posted do not join duty because of adverse and harsh conditions prevailing in those areas. There is nothing to cater their basic necessities like medical facilities, school, communication and other basic facilities. As a result of this, the pressure of poaching and hunting in the interiors of the state is very high and the entire area is practically unguarded and unprotected.

3. **Shifting Cultivation**: Shifting cultivation (Slash and Burn) in the state is practiced up to an altitude of 2,000m covering around 2,705 km^2 area which accounts for 3.2% of its geographic area (Singh, 1999). The shifting cultivation is very common along the slopes in the valleys of Ranga, Subansiri, Siang, Dibang and Tirap in the Subansiri, Papumpare, Siang, Lohit, Tirap and Changlang districts. It covers areas from tropical wet evergreen forests to pine forests. Earlier, the cycle of shifting cultivation was 3 years in Tirap and Changlang districts, 6 years in Lohit and Siang districts and 10 years in the Subansiri district. However, it has now come down to 2 to 4 years almost everywhere. This is responsible for the reduction and also fragmentation of the habitat. In the past, when the interval cycle of shifting cultivation was long, it was somewhat beneficial for some of the mountain ungulates. However, in its present form it is causing immense damage to the habitat of mountain ungulates.

4. **Developmental Activities**: The planners and leaders of this remote and backward state are trying hard to develop the infrastructure sector in the state to accelerate the pace of economic development. Consequently, construction of roads, bridges, dams, hydel power projects and development of townships has been taken up on a large scale. Such developmental

Table 1 Protected Areas of Arunachal Pradesh

S. No.	PROTECTED AREA	DISTRICT	AREA (km^2)	Year of Establish-ment	Mountain Ungulates Observed / Reported
1	Namdapha National Park	Changlang	1807.82	1983	Serow, Goral, Takin, Musk Deer, Bharal, Himalayan Tahr
2	Mouling National Park	Upper Siang	483.00	1986	Serow, Goral, Takin, Musk Deer
3	Pakke Wildlife Sanctuary	East Kameng	861.95	1977	Serow, Goral
4	Eaglenest Wildlife Sanctuary	West Kameng	217.00	1989	Serow, Goral
5	Itanagar Wildlife Sanctuary	Papum Pare	140.30	1978	Serow
6	Tale Valley Wildlife Sanctuary	Lower Subansiri	337.00	1995	Serow, Goral
7	Kane Wildlife Sanctuary	West Siang	55.00	1991	No Reports
8	D' Ering Wildlife Sanctuary	East Siang	190.00	1978	No Reports
9	Yordi – Rabe Supse Wildlife Sanctuary	West Siang	491.61	1996	Serow, Goral
10	Mehao Wildlife Sanctuary	Diabang Valley	281.50	1980	Serow, Musk Deer
11	Dibang Wildlife Sanctuary	Diabang Valley	4149.00	1991	Serow, Goral, Takin, Musk Deer
12	Kamlang Wildlife Sanctuary	Lohit	783.00	1989	Serow, Goral, Takin
13	Sessa Orchid Sanctuary	West Kameng	100.00	1989	Serow, Goral
14	Dihang – Dibang Biosphere Reserve	Dibang Valley Upper Siang West Siang	5111.5	1998	Serow, Goral, Takin, Musk Deer

projects in these hilly areas have, however, been taken up without adequate environmental considerations. The result is deforestation, soil erosion and damage to the ecological balance. Horticultural plantations and agriculture is being taken up along steep slopes. All these activities are a potent threat to the future of ungulates. The tribal people of the region are backward and their quality of life needs to be improved definitely to keep them in the national mainstream and also at par with the developments taking place in the other parts of the country. However, a judicious balance needs to be maintained between developmental and environmental considerations for the benefit of one and all.

5. **Awareness Programmes**: The tribal people living in the higher reaches of the state are not aware of the provisions of the Wildlife (Protection) Act, 1972 and other legal enactments in this regard. Most of the habitat of the mountain ungulates is categorized as Unclassed State Forests (USF). The individual tribal communities have been exercising traditional rights over these areas since long. The attempts of the Forest Department to control and manage the USF areas are being met with strong resistance from the local communities. Moreover, in dealing with such cases the tribal customary law is given preference over the statutory law. They still feel that the wildlife available in their areas is meant for their use, as has been the practice since generations. As such they feel it as their right to freely use wildlife found in their areas for their sustenance. Therefore, awareness programmes in these areas have to

be taken up by the agencies other than the Forest Department also on a large scale. Moreover, other alternatives for these people have to be introduced to remove the demand and to save the mountain ungulates.

Arunachal Pradesh is economically not developed. This state does not have its own resources to generate enough revenue to meet the demands for its all round development. It depends upon the Central grants and assistance for its ongoing development projects. The financial resources available with the state are spent upon priority areas like infrastructure and social security. As such, the state is not left with any surplus resources at its command to spare for forestry and the wildlife sector. For a backward state like Arunachal Pradesh, the investment on forestry and wildlife is not on its priority. Therefore, the allocation for the forestry and wildlife sector in the annual plans of the state is negligible. The result is complete neglect of this sector. The Government of India and other conservation agencies should come forward to help the state government set up infrastructure needed for this sector. The state government on its own is not in a position to provide necessary financial requirements for the forestry and wildlife sector.

The research, survey and conservation education activities in the state have to be strengthened. For this purpose, different Government agencies and non-governmental organizations working in the field of biodiversity conservation should come forward to undertake/initiate research and conservation education/ awareness programmes in the remote and inaccessible areas of the state. This is required to create at least baseline data which would help for the planning of the required protection measures on sound scientific principles.

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Chapter 9

Conservation issues in the Himalayan region of India

G. S. Rawat & S. Sathyakumar

1. Introduction

The Himalayan region is bestowed with varied landscape features that provide multitude of habitats to a diverse array of faunal communities including several species of wild ungulates (Prater 1980, Section 1 of this issue). The region covers nearly 11% of India's geographical area and range from sub-tropical to alpine zones. The region is well known for extensive alpine biome, temperate conifer and broadleaf forests, sub-tropical (foot-hill) forests, temperate grassy slopes, and various other habitats. Despite tremendous potential, most of the areas in this region exhibit low abundance of wild ungulates. It is an irony that there are more Himalayan Tahr (*Hemitragus jemlahicus*) in New Zealand in comparison to the Himalayan region (Caughley 1967, 1970). This fact generally speaks of the status of wild ungulates in the region. Most of the ungulates are found in small isolated pockets and largely restricted to Protected Areas (PAs). Even within the PAs, especially in the eastern Himalaya and adjacent hill states, wildlife and ungulate densities are very low (Katti *et al.,* 1990). It is not surprising that a naturalist, having conducted large mammal surveys in the eastern Himalaya, is known to have commented, *"the stage is beautiful but many of the actors are missing".*

Questions on mountain ungulate conservation in the Greater Himalaya range from 'What are the reasons for low ungulate abundance in the Himalayan region' to 'What are the major issues pertaining to their conservation' and 'What are the ways and means to achieve better conservation status for mammals in general and the ungulates in particular'. We address these issues and strategies for conservation for mountain ungulates in the Greater Himalaya in this article.

2. Major Conservation Issues

Several factors have led to low abundance and poor conservation status of ungulates in the Himalayan region. Firstly, the Himalayan ecosystem is relatively young, fragile and low in primary productivity. With the increase in human population the area has undergone rapid degradation, fragmentation and loss of wildlife habitat. Poaching and trade of animal parts, competitive exclusion by the domestic livestock, faulty land use practices, and human - wildlife conflicts are other factors affecting wild ungulates and other faunal communities (Gaston *et al.*, 1983, Green 1985, Sathyakumar 1994, Sathyakumar *et al.* 1993, Vinod & Sathyakumar 1999). Some of the issues related to conservation of wildlife ungulates are discussed below.

2.1. Habitat degradation and fragmentation

i. Alpine Habitats of the Greater Himalaya: The region above natural tree line (*ca*. 3300 – 3600 m above mean sea level in

the western and north-western and *ca*. 3600 – 3800 m in the central and eastern Himalaya) represent alpine habitats which are characterized by treeless vegetation, alpine scrub and meadows. The ungulates frequently inhabiting this zone are Blue sheep (*Pseudois nayaur*), Himalayan musk deer (*Moschus chrysogaster*), and Himalayan tahr. The major causes leading to degradation and fragmentation of alpine habitats include overgrazing by livestock (Kala and Rawat 1999), commercial harvest of wild medicinal herbs, uncontrolled tourism and mountaineering in certain areas (Sathyakumar 1993a). The area is very prone to soil erosion, avalanches and landslides owing to steep and fragile terrain. Very few PAs in the region give complete protection to alpine habitats except a few (e.g., Valley of Flowers NP and Nanda Devi National Park [NP] in Uttaranchal). However, a majority of the PAs remain neglected in terms of management even though they represent important habitats for typical faunal communities (Kothari 1995, Rawal & Dhar 2001).

ii. Sub-alpine Forests: The area between *ca.* 3000 m and natural 'tree line' represents an important ecological belt throughout the Himalaya. Besides Himalayan musk deer and serow (*Nemorhaedus sumatraensis*), it forms summer habitat for two important ungulates *viz.*, *Hangul (Cervus elaphus hanglu*) in the west (Kashmir Valley) and Takin (*Budorcas taxicolor*) in the east (Mishmi hills, Arunachal Pradesh). Of all the habitats in the Himalayan region, the sub-alpine forests have undergone maximum degradation and fragmentation owing to anthropogenic activities such as collection of non-timber forest produce (including montane bamboo, mushroom, medicinal and aromatic plants), poaching, livestock grazing and camping by the herders (Awasthi *et. al*. communicated). Sathyakumar *et al.* (1993) have reported that increased livestock grazing and associated impacts have led to low musk deer densities in many areas in Kedarnath Wildlife Sanctuary. The subalpine forests, 'tree line' and the alpine scrub interspersed with alpine meadows is the optimal habitat for musk deer but this habitat, particularly the 'tree line' has degraded in many parts of the Himalaya due to cumulative impacts of livestock grazing. Most graziers prefer to camp and graze their livestock in and around 'tree line' due to availability of fuel wood, water, food and cover for livestock.

iii. Montane forests of North-Western and Western Himalaya: The forested habitats in middle elevation rages (1500 - 3000 m) in the western and north-western Himalaya exhibit a great diversity of flora and fauna. The major vegetation types include Himalayan Dry Temperate (conifer), Himalayan Moist Temperate (broadleaf), and several other categories (Champion & Seth 1967, Singh and Singh 1987). In many areas (especially on south facing gentle slopes) the forests have been transformed into the scrub jungle and cultivation. The common ungulates of the forested habitat include Himalayan musk deer, serow, goral, sambar (*Cervus unicolor*), barking deer (*Munitacus muntjac*) and wild pig (*Sus scrofa*). Much of the forested habitats in the region are affected by encroachment for habitation and cultivation, livestock grazing, lopping of trees for fodder. These activities have led to failure of regeneration and resultant change in the structure and composition of forests. Rawat *et al.* (1999) have reported that plant species diversity have changed with an increase in unpalatable

plant species in the fringes of Kedarnath Wildlife Sanctuary as a result of human use. The forests of Western Himalaya are rich in wild mushrooms including highly prized morel (*Morchella esculenta*). Local people, in large groups, visit several parts of such PAs in order to collect this mushroom thereby causing heavy disturbances and affecting the threatened and sensitive species of fauna such as Himalayan musk deer and pheasants (Vinod and Sathyakumar 1999, Ramesh *et al.* 1999).

iv. Central and East Himalayan Montane Forests: Major forest types in the middle elevation (1500-3000 m) ranges of Sikkim (Central Himalaya) and Arunachal Pradesh include Temperate Broadleaf Forests, Conifer forests and bamboo brakes. These forests support Himalayan musk deer, serow, takin, several other ungulates such as Asian elephant (*Elephas maximus*), gaur (*Bos gaurus*), sambar, wild pig and various other mammals including primates, and carnivores. But for the occasional fire (localized in certain areas) and slash and burn agriculture in some parts of Arunachal Pradesh, much of the forested habitats in the central and eastern Himalaya are intact (IIRS 2002).

v. The Shivaliks and sub-Himalayan Forests: This zone (<1500 m) represents the sub-tropical climate, varied topography, rich alluvial soils and intermingling of taxa from the Indo-malayan and Palaearctic regions. The major forest formations, according Champion & Seth (1968) include Sub-tropical Dry Evergreen Forests, Sub-tropical Pine Forests, Northern Dry Mixed Deciduous Forest, Dry Shivalik Sal Forest, Moist Mixed Deciduous Forest, Sub-tropical Broadleaf Wet Hill Forest, Northern Tropical Semi-evergreen Forest, and Northern Tropical Wet-evergreen Forest. The Shivalik hills are best represented between the Ganges and Yamuna rivers in Uttaranchal. The entire belt all along covers an area of *ca*. 40,000 km^2 of which only <2100 km^2 area falls under PAs represented by Simbalbara WS, Rajaji and Corbett NPs. Ecologically, entire Shivalik belt is considered as highly sensitive zone. This region suffers heavy fragmentation and degradation of habitat due to human encroachment and proliferation of exotic weeds such as *Lantana camara, Parthenium hysterophorus, Cassia tora*, and *Sida* spp. Hajra (2002), based on the analysis of remote sensing data of Shivalik zone in Uttaranchal found that even though south facing slopes appear to be suitable for goral, but only about 13% area was moderately suitable and less than 1% area is highly suitable for this species. Rest of the area is either forested or very steep and not available for goral.

vi. The North – Eastern Hills: The natural landscapes and habitats in this region have been extensively modified due to shifting cultivation or slash and burn (*Jhum*) agriculture. Besides, pressure on the land due to exploitation of forest for timber and lack of a scientific forest management has led to proliferation of exotic weeds and degradation of forests. With tremendous increase in human population during recent decades the *jhum* cycle has come down from 20-30 years to about 5 years and even up to 3 years in many areas. Reduction in *jhum* cycle due to increase in pressure on land has accelerated the process of habitat degradation and fragmentation which has affected ungulates and other faunal groups in the region (Mishra *et al.,* 1994).

vii. Temperate Grassy Slopes: The temperate belt in the western and north-western Himalaya support an extensive grassland habitat which is largely anthropogenic in nature. These grassy slopes have developed largely on the south facing, steeper slopes which cannot be cultivated and are burned during winter to promote grass growth. Such slopes are grazed and maintained as hay slopes or '*Ghasnis*' in many sectors of Western Himalaya. The steeper and inaccessible areas are occupied by Himalayan tahr and goral (Schaller 1973, Cavallini 1990, Johnsingh 1992, Lovari & Apollonio 1993, Sathyakumar 1994, Mishra & Johnsingh 1997). Goral is one of the prominent species of mountain ungulates that has evolved in this habitat in the region (Mishra 1993, Pendharkar 1993). The gentler slopes close to human habitation have degraded over the years and goral habitat has been reduced considerably. The temperate grassy slopes and adjacent woodlands of Dachigam NP, Kashmir valley support a highly threatened subspecies, the *Hangul* or Kashmir stag. The grassy slopes of Dachigam are also reported to have degraded considerably over the years (Khursheed Ahmed, *personal communication*).

2.2 Habitat Loss

Excessive degradation and fragmentation eventually leads to habitat loss. Systematic studies documenting loss of ungulate habitats in the Himalayan region are lacking . Hence, it is difficult to point out clear cases of this phenomenon. However, in most of the sectors, there are plenty of evidences indicating the shrinkage of wildlife / ungulate habitat. Green (1986) reported that over 70% of potential musk deer habitat has already been lost due to habitat loss and habitat degradation in the southern side of the Greater Himalaya. Based on the spatial time-series analysis of remote sensing data, Awasthi (2001) has pointed out that in upper regions of Bhagirathi Valley, Garhwal Himalaya there has been a considerable increase in the area of human inhabitation and cultivation during last 30 years. This study also indicates that much of the sub-alpine and temperate broadleaf forests have converted into scrub vegetation. Conversion of forested habitat into scrub, is in a way loss of habitat especially for the sensitive ungulates such as Himalayan musk deer. Displacement of human populations for the developmental projects, construction of roads along the sensitive habitats, encroachment of forests for agriculture and heavy infestation of exotic weeds are other causes of habitat loss in the region.

2.3. Competition with domestic livestock

Owing to high seasonality and low primary productivity, the Himalayan region supports relatively low ungulate / herbivore biomass. It is therefore, obvious that with the increase in the biomass of domestic livestock in many areas, wild ungulates have suffered competitive exclusion. Rawat (1998) has pointed out that several areas in the Himalaya there is an overstocking of livestock leading to decreased productivity and degradation of pastures. Sathyakumar *et al.* (1993) have reported that increased livestock grazing and associated impacts have led to low musk deer densities in many areas in Kedarnath Wildlife Sanctuary. Although animal husbandry is one of the main stay of livelihood in the Himalayan region, the management of livestock especially disease surveillance, rotational grazing and pasture management have been

neglected leading to conflicts with wildlife as well as PA managers.

Poaching: All mountain ungulates of the Greater Himalaya are seriously threatened due to poaching for meat, skin/hide, and for products such as the 'musk' from Musk deer.

Poaching for meat (bush meat hunting) is common in many parts of the Greater Himalaya, particularly in the Eastern Himalaya (See Section II – Arunachal Pradesh State Report). Species such as the goral, tahr, serow, takin are poached for meat/hide by local villagers and indigenous people throughout their distribution range. There are instances of wild mountain ungulate meat served in local restaurants in towns or villages adjoining wilderness areas. Although, the extent of poaching by local villagers or indigenous people is not known, there are evidences of the consequences of high poaching levels in many areas where mountain ungulates have become either locally extinct or occur in very low densities. Poaching for sport and meat by the personnel of the security forces in the international border areas, also have led to serious impacts on mountain ungulate populations.

Poaching of musk deer for 'musk' is rampant through out the Greater Himalaya for its high commercial value (about US $ 65,000/kg in 1985) in the international markets (Green 1986, Sathyakumar 1993b). This has led to local extinctions of this species in many parts of the Greater Himalaya. As a result, the once continuous distribution of musk deer is now confined to some isolated pockets and in most of these areas they occur in very low densities. Similarly, poaching of Himalayan tahr and goral have either resulted in local extinctions or very low densities in many areas.

3. General Strategies for Conservation

1. Most of the protected areas in the Himalayan region lack adequate man power and funds for proper management. In addition, several PAs have ill defined boundaries leading to conflicts between the local communities and PA management. There is an urgent need to strengthen the management of most of the PAs allocating more well trained and motivated staff, budget and infra-structure.

2. Several PAs and Reserved Forests in the Himalayan region need to be brought under community reserves where local people could be made partners in conservation and management. Through various programmes such as community based eco-tourism and participatory management of natural resources the illegal activities such as trade of animal parts and poaching could be gradually brought down.

3. There is an urgent need to increase trans-boundary co-operation between India – Nepal, India – China and India – Myanmar to control the illegal trade of wildlife products. Measures should be taken to register all the arms (licensed guns, etc) with the Wildlife warden or the Divisional Forest/Wildlife Officer.

4. Currently, there is no organised system of harvesting wild medicinal and aromatic plants and uncontrolled harvest often results in the degradation of habitat. There is a need to evolve policies related to rotational harvest of medicinal plants for the benefit of communities and there is a need to control excessive pressure

on the land. As part of eco-development measure cultivation of medicinal plants needs to be promoted in the buffer zones of various PAs where human pressure for these commodities is excessive.

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Chapter 10

A Regional Perspective for Snow Leopard Conservation in the Indian Trans-Himalaya

Y.V.Bhatnagar, V.B. Mathur & Tom McCarthy

Introduction

Wildlife in India, especially the large mammals are primarily concentrated in the Protected Areas (PAs), which to have become habitat islands, isolated by vast stretches of unsuitable habitat for wildlife. Human population has been constantly increasing in the country and has recently crossed the one billion mark. At present about 4.7% of the country's 3.3 million km^2 geographic area is under National Parks (NPs) and Wildlife Sanctuaries (WLS), and there are plans to increase this to *ca.* 5.7% in order to make the PA network biogeographically more representative (Rodgers *et al.* 2000). The human pressure on India's wild lands has been constantly increasing, with more and more cases of serious conflicts between people and parks being reported. Wildlife conservation in India has a long history of management through 'policing' the PAs. It is only in the past two decades or so that conservationists and park managers have realized that exclusion of people completely from PAs is not a viable option - a realization that has thrown up numerous challenges. The fact that a majority of Indian PAs have not been legally gazetted due to non settlement of the rights and concessions of local communities residing inside the PAs also calls for a review of this situation. Fortunately, the amendment to the Indian Wildlife Protection Act (2002) by inclusion of two additional categories of PAs *viz.* Conservation Reserve and Community Reserve would provide a pragmatic solution to this hitherto unresolved issue through rationalization of PA boundaries.

PAs in India and elsewhere are meant to preserve and protect a range of conservation values. Each PA has specific objectives of management. Many of the objectives and conservation issues are common to a vast variety of PAs. One such objective for most Trans-Himalayan PAs is the conservation and maintenance of a viable snow leopard (*Uncia uncia*) population as a 'flagship species' (Anon. 1988). Further, when conservation objectives and issues are similar, solutions may be as well, although adaptations for local conditions may be necessary. Often, managing and monitoring all aspects of biodiversity in a PA is difficult and hence, managers tend to concentrate on focal species that guide conservation efforts for the area (Simberloff 1998). As per a critique on the single species management approach by Simberloff (1998), these species may be 'flagship species'; one that is 'normally a charismatic large vertebrate, one that can be used to anchor a conservation campaign because it arouses public interest and sympathy'. Or it may be an indicator species, one that is usually sensitive to disturbance in the ecosystem

that they represent and their population abundance is indicative of a healthy ecosystem. A third species oriented approach is to have an 'umbrella species', which needs such large tracts for its conservation that saving this species automatically saves an entire range of species occurring within its habitat.

The snow leopard is a charismatic large carnivore, distributed over most of the Trans-Himalaya and the Greater Himalaya (Box 1). The sympathy and appeal that the snow leopard has drawn internationally is self-evident. The International Snow Leopard Trust (ISLT), an organization completely dedicated to the cause of the snow leopard conservation has been in existence for over two decades now, with programmes in several of the 12 range countries including India. Within India as well, an entire conservation and management program focused on the snow leopard was proposed several years ago, some what along the lines of Project Tiger (Anon. 1988). Apart from its appeal in garnering public support and funding, which renders it a valuable flagship species for conservation, its large home ranges and ubiquitous distribution in the Indian Trans-Himalaya make the snow leopard a suitable umbrella species as well. Importantly, the serious conservation issues in the Trans-Himalayan region – livestock grazing and associated out-competition of wild prey as well as livestock depredation—both involve or affect the snow leopard directly or indirectly. It is therefore imperative that the snow leopard conservation in the Trans-Himalaya should have a regional perspective involving range states and line agencies, which influence its conservation status in one way or the other.

In this paper, we use the above reasoning to say that the snow leopard qualifies both as a flagship and an umbrella species representing the Trans-Himalayan ecosystem and that its conservation would mean the conservation of the Trans-Himalayan region as a whole. We also try to detail how the resource-deficient Trans-Himalayan region is special, where most of the region still has wildlife values and where communities or individual families have traditional rights over all usable land. Hence, conservation challenges of the region will not be addressed by merely increasing the area under PA network, but by ensuring effective conservation measures in the larger region and by increasing the stake of the local communities in snow leopard conservation by providing viable livelihood support options.

The Trans-Himalayan Landscape

The Trans-Himalayan region is a cold, arid, mountainous landscape that covers the rain shadow regions immediately north of the Himalaya. The region is characterized by severe winters lasting over six months, with temperatures dropping to as low as - 50°C in some places. Another characteristic of the region is the short plant growth season of merely two to three months, when productivity is usually low. These harsh conditions have given rise to hardy and highly adapted flora, fauna and people.

Within India, the Himalaya and Trans-Himalaya are included in six states. Of these, the Ladakh region of Jammu and Kashmir, Lahul-Spiti region of Himachal Pradesh, and northern Sikkim have Trans-Himalayan areas that cover approximately 1.85 lakh km^2 (Rodgers *et al.* 2000).

BOX 1

SNOW LEOPARD - AN ELUSIVE CARNIVORE

Snow leopard is an elusive cat with a potential range of approximately 2.4 million km^2 in the arid mountain tracts of Central Asia, the Trans-Himalaya and the Himalaya (Jackson and Hunter 1996). Even though it has a relatively large global range, it has gone extinct locally at many places and at present are distributed in fragmented populations spread over less than 1.6 million km^2 (Jackson and Hunter 1996). A coarse, but best possible estimate of its global population is 3,500 - 7,500 animals. In India, it ranges over some 75,000 km^2, yet number only 200 to 600 (Fox 1994). Because of this precarious status, the snow leopard is included in the Schedule I of the Indian Wildlife (Protection) Act 1972 (Anon. 1992) and as 'endangered' in the IUCN's Red List (Nowell and Jackson 1996).

Snow leopard prefers rugged mountain tracts with abundant prey and stalking cover (Schaller 1977, Jackson and Ahlborn 1984, Chundawat 1992, McCarthy 2000). However, in much of the Tibetan plateau and Mongolia, snow leopard occurs in open, rolling habitats where shrubs and outcrops offer cover for stalking of abundant prey (Mallon 1984, Schaller *et al.* 1988, McCarthy 2000). The primary prey species of snow leopard in its range are bharal (*Pseudois nayaur*) and ibex (*Capra ibex sibirica*), although others such as urial (*Ovis vignei*), argali (*Ovis ammon*), markhor (*Capra falconeri*), wild goat (*Capra agegrus*) and marmot (*Marmota* spp.) may also be important locally (Schaller 1977, Chundawat and Rawat 1994). Estimates suggest that each snow leopard needs approximately 20 to 30 adult bharal annually (Jackson and Ahlborn 1984). Other estimates suggest that snow leopards need *ca.* 730 kg of meat annually from their large prey species such as bharal, and other smaller ones such as domestic sheep, goats, marmots and birds (Chundawat and Rawat 1994). Snow leopard distribution and status in the wild may be adversely impacted by low prey density, leading to increased depredation on domestic stock, thus causing conflicts with resident herders (Oli *et al.* 1994, Mishra 1997, Jackson 2000).

While a limited number of studies have yielded modest information on snow leopard ecology (Chundawat 1992, Jackson 1996, McCarthy 2000), even less information on population status across the range is available. The population and range figures above are largely educated guesses, however, snow leopard most certainly occurs in small and isolated populations, thus increasing the threat of the extinction (Jackson and Ahlborn 1990). Information on population status and structure is however very important to determine viability of populations. The reason for the lack of information on populations of snow leopard is because of the elusive nature of the species and the harsh habitat that it occupies. Snow leopard tends to move, bed and mark along linear geographical features such as crests, major ridgelines, at the base of cliffs and in gullies. Monitoring for signs along these features is the best possible way at present of estimating snow leopard population trends in an area (Jackson and Hunter 1996). This practice is however not in wide use at present. Use of genetic tools and camera trapping are other viable alternatives for gathering information on snow leopard abundance but are expensive.

The fact that the snow leopard has a wide distribution in the Trans-Himalaya and that it is the apex predator in most of this region enables the species to be used as a 'flagship species' and an 'umbrella species' to guide conservation efforts in the region, as was recognized by the Government of India in the 1980's (Anon. 1988). In this paper, we reckon that all conservation activities directed at snow leopards would benefit the ecosystem, and any conservation activity in the region including livelihood support to the local communities will also benefit the snow leopard directly or indirectly.

Uttaranchal and Arunachal Pradesh, along with the other three states mentioned above, have alpine and high arid areas on their northern boundaries that also comprise snow leopard range in India. The entire Himalayan block (2.1 lakh km^2) is classified as the Biogeographic Zone 02 (Province A to D), or 'Himalaya' (Rodgers and Panwar 1988), but the higher reaches, the Greater Himalaya, that constitutes the snow leopard range, is a narrow belt quite distinct in topography, climate and vegetation from the rest of the Himalaya – being much colder, arid and being devoid of forests.

The Trans-Himalayan region in India forms the catchment of three major rivers. In the northwest, the Indus, with its major tributaries - Zanskar and Shyok, drains the entire Ladakh region. South of this, the Chenab river, with its tributaries, the Chandra and Bhaga rivers, drains the Lahul valley. East of Lahul is the Spiti valley that drains into the Sutluj river, which passes through the Kinnaur region. Within India two provinces in the Trans-Himalaya are recognized (Rodgers and Panwar 1988). The 'Ladakh Mountains' constitute approximately 60% of the Trans-Himalayan zone and is spread in the Kargil, Zanskar, Leh, Nubra, and Lahul-Spiti regions of Jammu and Kashmir and Himachal Pradesh. These areas are mostly rugged mountains and valleys and have a large altitudinal range from 2,200m in the Kargil and Nubra regions to over 7,000m in the Karakorum range. The second province is the 'Tibetan Plateau' that constitutes the remaining 40% of the Trans-Himalaya. This region includes Changthang in Ladakh, parts of Spiti and the northern plateaus of Sikkim and is characterized by vast plains, rolling mountains and some large high-altitude lakes. Most of this region lies above an elevation of 4,200m.

In spite of the overall low numbers of species of plants and animals in the Trans-Himalaya (Das 1966), the region is home to an array of highly specialized assemblage of flora and fauna. There are over 600 flowering plants and numerous species of graminoids many with significant ethnobotanical value as medicinal plants, forage for livestock, or fuel (Kala 2001). The region is also home to over 225 bird species, including numerous breeding waterfowl (Pfister 1998, Singh and Jayapal 2001). Some of these species, such as the black necked crane (*Grus nigricollis*) and the bar headed geese (*Anser indicus*) are of considerable conservation significance. The region has gained further importance as it has over six species and sub-species of wild sheep and goats that are an important genetic resource from the region. There are numerous mammal species in the region that are classified in the Schedule I and II of the Indian Wildlife (Protection) Act 1972 and some of these are listed in Appendix 1 of CITES. Ecological information on all species from India is scarce, however, some details about bharal and snow leopard are known (Chundawat 1992). Ibex ecology was described by Bhatnagar (1997) and Manjrekar (1997). Information on the status and distribution of species have been reported by Fox *et al.* (1991), Mallon (1991), Shah (1994, 1996), Chundawat and Qureshi (1999) and Bhatnagar and Wangchuk (2001).

Although data on land ownership are not easily available, bulk of the land is State owned with traditional rights of use held

by communities or individuals. Most usable land is already utilized as pastures, agricultural land, and for the collection of fuel, fodder and housing material.

Existing Conservation Scenario in the Trans Himalaya - Wildlife Protected Areas in the region

Keeping our focus on snow leopard conservation, we mention here PAs in the Himalaya and the Trans-Himalaya. However, realizing that a relatively small portion of the Himalaya would qualify as snow leopard habitat, the discussion in the subsequent sections primarily deals with the Trans-Himalayan region.

Reliable information regarding the presence of snow leopard is absent for most PAs in the Indian Himalaya. Based on information that we have gleaned from literature and our own studies, there are 25 PAs within India that have potential for snow leopard occurrence (Mallon 1987, Anon. 1988, Fox *et al*. 1988, Bhatnagar 1997). There are two National Parks (NP) and three Wildlife Sanctuaries (WLS) in the Trans-Himalaya, together constituting *ca.* 15,000 km^2 or 8.2 % of the Trans-Himalayan zone in India (Table 1). There are nine NPs and 11 WLS in the Greater Himalayan zone with coverage of a further *ca.* 15,000 km^2 (7.6 % of the zone 02) that may have snow leopards. Most of the PAs in the Greater Himalaya have very small portions in snow leopard habitat and the extent of such areas is not yet documented. Further, in at least three NPs and five WLS of this region with an area of 6,600 km^2, the presence of snow leopard is very doubtful (Table 1). There are a few other erstwhile Hunting Reserves in the Kargil District of Ladakh, however their present status after the adoption of the Jammu & Kashmir Wildlife (Protection) Act (2002) is not clear.

It is evident from Table 1 that 17 of the 25 PAs (68%) with a potential for snow leopards are smaller than 1000 km^2, with five of them being smaller than 100 km^2. There are a further three PAs in the 1001 to 2000 km^2, two in the 2001 to 4000 km^2, and three in the > 4000 km^2 range. In areas where PAs are habitat 'islands' the smaller PAs, especially those smaller than 100km^2, have little potential for long-term maintenance of viable snow leopard populations (Jackson and Ahlborn 1990). Even within the larger PAs there are numerous limitations at present. From Table 1 and Fig 1, it is apparent that the PA network in the Trans-Himalayan and the Greater Himalayan zones is comparatively large in extent. Also, it is evident that the region has some of the largest PAs in the country (Rodgers *et al.* 2000). However, the following facts need to be critically examined:

1. Some PAs such as the Karakorum WLS are large, but have unclear boundary demarcation. There are over 15 towns and villages and numerous military establishments within the area. The human population in the region is over 10,000 (Anon. 1998a). There is also a great amount of military activity and vehicular traffic in the area, and all these factors render the area barely qualified as a wildlife sanctuary. This, and other similar areas, however, inflate the proportion of area under PA network in the zone.
2. Most PAs have up to 50% of their area under permanent ice or glaciers, shear and large rock

Table 1: Protected Areas in the Trans-Himalaya in India and the Greater Himalaya (adjacent to the Trans Himalaya and with potential for snow leopard occurrence). Figures in parenthesis are percentage of the PA category in the biogeographic zone. Total land area in the Trans-Himalaya is *ca.* 1,84,900 km² and in the Zone 2, that includes the Greater Himalaya is *ca.* 2,10,600 km².

S. No.	PA Name*	Biogeog. Zone (Rodgers *et al.* 2000) & State*	Area (km^2)*	Remarks
	Trans-Himalaya			
1	Hemis NP	1A, Jammu & Kashmir (J&K)	4100	
2	Pin Valley NP	1A, Himachal Pradesh (HP)	675	
	Total (National Park)		**4,775,** (2.6%)	
3	Karakorum WLS	1A, J&K	5000	Boundaries not well demarcated
4	Changthang WLS	1B, J&K	4000	Small portion of PA is snow leopard habitat
5	Kibber WLS	1B, HP	1401	
	Total (Wildlife Sanctuary)		**10,401,** (5.6%)	
	Grand total for Trans-Himalaya		**15,176,** (8.2%)	
	Greater Himalaya			
6	Gangotri NP	2B, Uttaranchal (UT)	2390	Small portion of PA is snow leopard habitat
7	Kanchendzonga NP	1B, 2C, Sikkim	1784	
8	Great Himalayan NP	2A, HP	754	Small portion of PA is snow leopard habitat
9	Nanda Devi NP	2B, UT	630	
10	Govind NP	2B, UT	472	
11	Kisthwar NP	2A, J&K	400	
12	Dachigam NP	2A, J&K	141	?
13	Valley of Flowers NP	2B, UT	88	?
14	Namdapha NP	2D, Arunachal Pradesh (AP)	1985	?
	Total (National Park)		**8,644,** (4.1%)	
15	Kedarnath WLS	2B, UT	957	Small portion of PA is snow leopard habitat
16	Sangla WLS	2B, HP	650	
17	Askot WLS	2B, UT	600	Small portion of PA is snow leopard habitat
18	Govind Pashu Vihar WLS	2B, UT	481	Small portion of PA is snow leopard habitat
19	Rupi-Bhaba WLS	2A, HP	125	
20	Lipa-Asrang WLS	2A, HP	31	
21	Dibang WLS	2D, AP	4149	?
22	Sechu Tuan Nala WLS	2A, HP	103	?
23	Sainj WLS	2A, HP	90	?
24	Kanawar WLS	2A, HP	54	?
25	Manali WLS	2A, HP	32	?
	Total (Wildlife Sanctuary)		**7,272,** (3.5%)	
	Grand total for Greater Himalaya		**15,916,** (7.6%)	

***** Information based on Rodgers *et al.* (2000)

? Snow leopard presence doubtful

faces, most of which have little wildlife values, thus further inflating the size, but not contributing to the wildlife values directly.

3. There are no Reserve Forests in the Trans-Himalaya that usually buffer disturbances in most wildlife PAs elsewhere in the country. Hence it is only the PAs in the Trans-Himalayan areas that have any legal status for the conservation of the native biodiversity.

Conservation issues in the Trans-Himalaya

A variety of physical, biotic and political characteristics of the Trans-Himalaya influence conservation issues that are peculiar to the region. Chief among the challenges is the limited resources available to the native population of the region. These populations which mostly occur at low to moderate densities of <2 persons per km^2, are primarily agro-pastoral, or, as in the Tibetan Plateau zone, are largely nomadic pastoralists. Human populations are increasing in the region with the breakup of the traditional polyandrous system and with fewer people opting for becoming celibate monks and nuns (Anon. 1998a, Mishra 2000). An important factor that needs to be considered is that in the harsh Trans-Himalayan landscape there is hardly any area that is not already in use by people at some time or the other during the year. Arable land is mostly limited to alluvial fans, and some stable areas in the valley bottoms. Almost all the available arable land is already under cultivation and all pastures are grazed by the domestic stocks at least seasonally. Addition of newer areas under some poverty alleviation schemes incorporate development of expensive and long flow irrigation systems. Our observations show that these most frequently end up as failures since most of such channels are damaged by avalanches or are washed away by floods or simply break up due to the unstable substrate. Thus in spite of numerous efforts any significant addition of arable land is remote. National parks and sanctuaries in India do not permit consumptive use and require resettlement of people outside such areas (Anon. 1992). The point that we are driving at is that the Trans-Himalayan region has very specific and limited area for cultivation or use as pastures and thus offers no or very few alternatives for resettlement of people outside PAs. The region has other peculiarities such as very poor road access, power supply, and difficult communication, apart from a harsh climate during much of the year. These features of the region thus do not allow scope for conventional industrial development and employment in the region, as is possible in other regions of the country.

As far as the wildlife values are concerned a very important characteristic of the Trans-Himalayan area is that it provides almost continuous wildlife habitat (Fox *et al.* 1991, Chundawat and Qureshi 1999, Bhatnagar and Wangchuk 2001). Almost the entire landscape has large mammals, including the snow leopard and wolf, but the densities may vary greatly from very poor areas to small pockets that may be rich in some large mammals. This means that a large amount of wildlife may actually be occurring outside existing PAs. In Nepal, for example, over 60% of the snow leopards are thought to occur outside PAs. In India, our coarse estimate is that of the probable maximum of 600 snow leopards in India (Fox 1994), *ca.* 80% may be occurring outside PAs. Among other endangered wildlife species such as the Tibetan antelope, Tibetan gazelle,

Tibetan argali, brown bear, and kiang, the entire or substantial populations occur outside existing PAs (Chundawat and Qureshi 1999, Bhatnagar and Wangchuk 2001, Sathyakumar & Qureshi 2002). Mishra, (2001). has found that in Spiti, the Tabo area that is not within any PA has bharal densities that are higher than the Kibber Wildlife Sanctuary. Shah (1996) has found remnant populations of the highly endangered Tibetan gazelle and argali in unprotected areas in northern Sikkim. The paradox here is that in spite of a very large proportion of the Trans Himalaya being under the PA network, numerous endangered species continue to occur outside. With this, and the fact that the region in general is resource deficient, with few livelihood options for the local herders we need to reconsider the approach of having large national parks and wildlife sanctuaries as 'inviolate areas' in the region. This is a challenging situation and the lack of a vision for conservation, as usually defined by Management Plans for PAs is absent at present.

Conservation issues common to the area primarily relate to deficiencies of infrastructure and staff for PA management, grazing competition between wild and domestic herbivores, conflicts relating to damage to crops and livestock by wildlife, some levels of poaching of snow leopard and prey species, wildlife diseases and political issues. These issues were also flagged as the most important ones in a meeting between scientists and managers at Leh (Mathur 2001) and of numerous snow leopard experts from all over the snow leopard range countries (McCarthy and Chapron 2003). We now examine these issues in some detail:

Infrastructure and staff for PA management

In the harsh environs of the region, there is a severe shortage of staff, effective infrastructure and funds for the management of the PAs. For example Ladakh has *ca.* 13,100 km^2 under its PA network with a total park staff of merely about 20. This translates to 655 km^2 to every park staff - a completely ineffective strength to manage the region under any circumstance, but especially so under the difficult climatic and topograhic conditions in the Trans-Himalaya. The numerous existing tasks of the Wildlife Department range from protection, tourism management, verification of compensation claims to nature education activities in the PAs spread all over the *ca.* 45,000 km^2 Ladakh region. We also understand that most park staff lack the necessary clothing, equipment and housing necessary for effective work in the region. The situation in Lahul & Spiti is not very different. It is an urgent requirement for the Centre and State Governments to provision the necessary resources to these areas for effective conservation in the region.

Grazing competition between wild and domestic herbivores

The entire region has heavy dependence on livestock. While some of the people are agro-pastoralists, many are entirely pastoral. Estimates range from 10 to a few hundred livestock heads per household in the region (Mishra 1997, Richard 1999, Bhatnagar and Wangchuk 2001). Livestock population in the Indian Trans-Himalaya has been growing continuously in the past decades, as evidenced by data available from Ladakh, were the livestock population has almost doubled between 1972 and 1992 (Anon. 1998a, Bhatnagar

and Wangchuk 2001). Even though conclusive information on habitat degradation, and direct competition between domestic and wild herbivores from the region has just started coming (Mishra 2001), it is evident from some preliminary studies that the present livestock grazing levels in areas such as eastern Ladakh and Spiti may already be unsustainable (Mishra 2001, Bhatnagar and Wangchuk 2001, Raghavan 2003, Namgail 2003). The potential impacts of excessive grazing by livestock include depletion of the scarce forage for wildlife, habitat degradation, disease transfer, and reduction in the breeding performance of both wildlife and domestic stock (Mishra 2001).

Conclusive studies to ascertain impacts of livestock grazing need to be taken up at many sites. There is also an urgent need to see how the pastoral and agro-pastoral communities of the region can be drawn into a trade-off that reduces their dependence on large livestock holdings, while at the same time helps in improving their standard of living. An example for such an effort was made by the Nature Conservation Foundation, Mysore, and details are given in Box 2.

BOX 2

Kibber Grazing Reserve

The Nature Conservation Foundation, a science and conservation organization based in Mysore, signed a written agreement with the village council of Kibber in Spiti in the year 2000, where both these institutions resolved to protect a 5 km^2 area exclusively for wildlife by agreeing not to graze their livestock in that region. The rangeland area has been traditionally used for livestock grazing and collection of fuel, and medicinal plants. Two years of protection is already showing signs of wildlife recovery, as indicated by the increased use of the area by bharal. The compensation costs for lost grazing are being met with by the Van Tienhoven Foundation in the Netherlands, and the project is being implemented voluntarily by scientists associated with the Nature Conservation Foundation and the Wageningen University. The International Snow Leopard Trust has recently joined hands with the initiative, and these institutions are working together towards off-setting the costs that the local people are bearing for living with wildlife (through programs in conservation education, supporting self managed insurance schemes, value addition to local handicrafts), and towards enabling the local people to benefit from the wildlife they share their resources with (wildlife tourism).

Conflicts relating to damage of crops and pastures by wild herbivores

The Jammu and Kashmir Department of Wildlife Protection staff in Leh has been receiving compensation claims for damage to crops by species such as bharal and urial. The extent of such damage is not yet clear, but there is an increasing trend in such claims. There is a need to have a better record of conflict cases. 'Hotspots' of such conflict zones should be clearly identified and if any are found, participatory exercises should be taken up to minimize the losses.

In a surprising development some nomads and state Govt. officials claim that the kiang are now damaging the winter pastures of the valuable *pashmina* or Cashmire goats in Changthang (Fox *et al.* 1991, Richard 1999). It has been argued that such claims are largely baseless and are probably a result of reduced tolerence levels among the

people in recent times (Richard 1999, Bhatnagar and Wangchuk 2001).

Livestock depredation by wild carnivores

Livestock depredation seems to be a serious conservation issue in the Trans-Himalayan region. As indicated earlier, livestock rearing at present forms an important part of the local economy and any loss to livestock results in a direct monetary loss to the local herders. Park staff in Ladakh report that often up to 60% of their annual outlay goes in meeting the livestock depredation compensation claims filed by people (Rauf Zargar, Wildlife Warden, Leh, *Pers. Comm*.). Damage to livestock takes place in the pastures as well as in the night time corrals. In India's Trans-Himalayan zone only four studies have as yet quantified the extent of livestock damage due to depredation by wild carnivores. These studies are by Mishra (1997) from Spiti, Bhatnagar *et al.* (1999) from the Hemis NP, Ladakh, and by Jayapal (2001) and Sathyakumar (2001) from Zanskar, Ladakh. The damage to livestock in many of these areas is quite high and in some villages up to 14 animals per household have been lost in an year. The monetary loss to households in the Hemis NP averaged *ca.* Rs. 12,000/- during 1996-97 (Bhatnagar *et al.* 1999). This study also showed that over 40% of the losses were taking place in the corrals, an aspect that can be dealt with more easily than the damage in pastures. Small and effective means of alleviating these conflicts have been developed by ISLT and SLC, along with local NGOs and the Wildlife Department in Hemis NP, which has potential for replication elsewhere (Jackson and Jain 1999).

Integration of efforts by different Government Departments and Non-Government Organizations

Owing to the remoteness of the Trans-Himalayan region, the state governments have resorted to a system of governance that is called 'Single Line Administration'. Under this system, the district head, the District Commissioner (DC) or the Additional District Commissioner (ADC) becomes the head of all Government Departments working in the region. In addition, the Ladakh region, that constitutes bulk of the Trans-Himalayan region in India, has a Ladakh Autonomous Hill Development Council (LAHDC), a form of local Government.

After consultation with the Wildlife Department in Ladakh, it was apparent that inter-agency cooperation and coordination in the region is lacking, leading to inefficient functioning by the Wildlife Department (Mathur 2001). Examples of major developmental activities being undertaken inside wildlife PAs were cited as cases when the Wildlife Department had to stop such activities when they were well underway. This earned the ire of the local people as well as the respective Government Departments undertaking the work. For these reasons, we feel that the 'Single Line Administration' would facilitate coordination between Departments more effectively, specially if there are relevant policies and practices in place that make it imperative on the respective DCs or ADCs to keep wildlife conservation interest in mind before approval of any development schemes.

The Ladakh region has an added advantage of the existence of numerous

non-government organizations (NGOs), many of which have a good reputation of grassroots work in the fields of alternative sources of energy, organic agriculture, and education. This is a resource that should be effectively tapped for conservation related work.

Political issues

The entire Trans-Himalayan region has international borders. Ladakh has a large and hostile border along the west and northwest with Pakistan held Kashmir called the Line of Control (LoC). On the north and east is the international border and the Line of Actual Control (LAC) with China. Himachal Pradesh and Sikkim also share borders with China. Numerous stretches along these borders are disputed territory. Species such as the Tibetan antelope, argali, kiang and Tibetan gazelle occur at numerous places along and across the border with China (Fox *et al.* 1991, Shah 1996, Chundawat and Qureshi 1999, Bhatnagar and Wangchuk 2001). Good snow leopard, ibex and urial habitat occurs along the LoC. Often due to the sensitive nature of the region the Wildlife Departments have little control over the region. There is heavy presence of defence forces on both sides and wildlife of the region might also be a casualty to the frequent skirmishes. The problem is compounded when these may be the only places within the country where a species occurs. Trans-border conservation of these species should thus be given high priority.

Jammu and Kashmir has a separate Wildlife Protection Act, which had placed endangered species such as the Tibetan antelope and brown bear under Schedule II, for which hunting licenses could be given. The amended Act is however at par with the National legislation (Anon. 2002). The entire Trans Himalayan region spreads across three states and inter-state collaboration in conservation efforts though difficult, is nevertheless necessary.

What we want to stress here is that the political dimension is important to consider while planning any large-scale conservation effort in the Trans-Himalayan region, a region replete with sensitive borders spreading over three states.

Poaching of snow leopard and prey species

Sport hunting was quite widespread during the British period in the Trans-Himalaya (Stockley 1928, Ranjitsinh 1981). Even after independence the trend continued till the early 1980's when the defense forces, Government officials and others were known to hunt in various parts of the Trans-Himalaya, especially in Ladakh. This had decimated the populations of numerous species in the region (Ranjitsinh 1981, Fox *et al.* 1991). Recently, however, there is evidence of a decline in hunting in many parts of the Trans-Himalaya, with the revival of some wildlife populations in the region such as the Ladakh urial (Chundawat and Qureshi 1999).

Buddhism is the dominant religion in most of the Trans-Himalayan region in India and hunting is generally not practiced, unless it is in retaliation for some damage to their property. However, in western Ladakh and in Lahul, hunting might still be an issue. Again, little information exists on the extent of poaching going on in the region. Some illegal trade in wildlife products, including snow leopard parts

and *shahtoosh*, may be occurring in the region (Wright and Kumar 1997). We understand from the Wildlife Department in Leh that no hunting license has been issued since the mid-1980's. Until trends in poaching and wildlife trade in the region are better documented and understood suitable measures cannot be devised and undertaken to minimize the problem.

Wildlife Diseases

Wildlife disease can be damaging and may even lead to the extinction of small populations. This is particularly true for small, isolated populations as the Tibetan gazelle in Ladakh, and snow leopard in parts of the Trans-Himalaya. Information on wildlife disease from the region is, however, completely absent and there is an urgent need to generate such information. The reports of infectious diseases such as PPR and FMD in livestock of the region increase the threat of an epidemic in the wild herbivore populations. It is suspected that the frequent imports of livestock from the plains by the armed forces for meat could be a source of exotic diseases in the region. Effective quarantine and screening of all imported animals and vaccination programmes for livestock are needed for the entire region, but on priority for areas in and around the PAs or areas with endangered species.

The way forward

Some measures that could be undertaken in the region to aid conservation have already been discussed above in the section dealing with conservation issues in the Trans-Himalaya. What we give below is an indicative way of planning wildlife conservation in the region as a whole. We understand that these ideas will have to be fine tuned through wider stakeholder consultations. What we have tried to argue so far is that:

- Even though there are some large PAs in the Trans-Himalaya, bulk of these are occupied by permanent ice and sheer rock faces - the effective areas important for wildlife within them are usually small. Some of them may not even qualify as a PA.
- For existing PAs an effective vision for management is mostly absent.
- Most of the large mammals in the Trans-Himalaya, need large areas given the sparse resources, and seasonal movements. Further, wildlife in this region is mostly outside the existing PAs and simply adding more areas under the PA network may not be a viable solution.
- Areas in PAs usually form an important resource for native people, for whom few alternative livelihood options are available. Traditional concept of large inviolate PAs is not practical in the region.

Based on the conservation issues presented above, and the almost continuous wildlife distribution in the region, we feel that conservation in the Trans-Himalaya has to be planned with a regional perspective, in which the native people are taken as an integral part of the conservation efforts. Having large inviolate national parks and sanctuaries does not seem viable in the region. The shift of focus for conservation in private lands is a need recognized by conservationists worldwide (Knight 1999, Norton, 2000). Using this line of thinking, we feel that continuing with the existing scheme of PAs may not work in the Trans-Himalayas and we now need an alternate paradigm for wildlife conservation in the

region. One of the ways of moving ahead is to carefully work on the zonation of existing PAs and of the larger Trans-Himalayan landscape in general.

An alternate zonation concept

Zonation within existing PAs

PAs in India have zones of varying landuse, such as a core zone, which is inviolate, and a buffer zone that may have multiple-use (Anon. 1992, Sawarkar 1995). The latter zone further may have areas earmarked for forestry operations, tourism and other consumptive uses. Our information suggests that none of the existing PAs in the Trans-Himalaya have cores and buffers delineated. The NPs are essentially 'core zones' in their entirety. With the enhancement in the legal status of the WLS following the 1991 amendment of the Wildlife (Protection) Act, 1972, all the PAs constituting *ca.* 15,000 km^2 mentioned in Table 1 have technically become 'core zones'. Continuing with this practice, as we have already seen, is not pragmatic. We thus suggest that for the existing five PAs in the Trans-Himalaya we change the management zonation approach by carefully delineating core zones in a mosaic, with a buffer area surrounding it. The difference from the existing scheme, primarily is that we do not take impractically large areas of a few thousand km^2 as inviolate core zones and we have multiple core zones within any PA based on its value.

The steps to be followed may be as follows:

- Carefully survey all PAs to determine areas that have high wildlife value, either in terms of presence of an endangered species such as snow leopard, Tibetan gazelle or argali, or in the presence of a large diversity of large mammals.
- Designate such area as a core zone using a participatory approach (see also Box 2).
- Have at least one such core area for every 100 km^2 of the PA, although consideration of species movements may need to be included in their planning.
- The peoples rights may need to be settled using innovative schemes such as those outlined in Box 2 and in the section on conservation efforts below.
- The buffer zones would be all the remaining area in the PA where traditional use may continue. Attempts would however, be made to minimize the negative impacts of human use.
- Focused studies that help in determining suitable levels of use need to be encouraged.

In areas of the Trans-Himalaya outside existing PAs

The issue of conservation of wildlife outside PAs is more complex. As alluded to earlier, the need for this arises because:

- Endangered species like the snow leopard, Ladakh urial, Tibetan gazelle, argali and chiru occur mostly outside existing PAs
- Including all such areas under the PA network would mean that over 50% of the Trans Himalaya will need to come under the PA network
- Resources for managing such a large network, both material and human are not available
- It is likely to further increase people-park conflicts manifold

There is thus a need to recognize these areas for their importance and device strategies for their conservation. This is with the knowledge that local culture/ values and the ow human population density have an important contribution in wildlife persisting in these areas. Zonation seems one clear means to develop this strategy. We realize that aspects of what we present below may be theoretical but will surely be useful in developing a framework.

In the alternate approach, we suggest further four landuse zones, which have subtle differences in their management objectives. The first zone is the 'Conservation Zone' which is a small, carefully researched and selected area preferably measuring more than 10 km^2, and where ever possible, up to 100 km^2, where the local people agree to give up their rights in exchange of some development schemes (Box 2). These are then surrounded by the 'Alternate Livelihood Zone', which would be the most widespread zone. Here the various Government departments' and NGOs work together to limit livestock numbers and dependence on natural resources so as to allow sustainable utilization of resources. This zone can also have agro based and other non-polluting industries to create employment. The third zone can be 'Low Value Zone', which includes *unusable* areas under permanent ice and large rock faces. These areas will constitute a major portion of the area. The zone can also include narrow stretches of areas that have lost all value for maintenance of wildlife such as townships and excessively degraded areas.

These zones would go a long way in addressing the issue of conservation and development using a regional perspective.

Areas with information gaps and indicative actions

Additional livelihood options

At present, we have the options of cash crops such as green peas and potato that can be marketed as fresh vegetables in markets in the plains and locally. To minimize the loss through decay during transportation to markets, part of the produce could be processed locally into processed food products or health food. Another industry suggested is electronic industry that is usually less polluting to the environment. But issues regarding power and access need to be addressed first in order to make such ideas viable. The region needs better schools and colleges and has potential for establishment of national level educational institutions. For all these activities, enhancement of the present infrastructure is extremely important. Ladakh already attracts large number of international and domestic tourists. The benefits from tourism are however largely limited to a very small population within Ladakh. There is tremendous potential for development of ecotourism schemes in the region that would enable tourism to take place in a sustainable manner and with substantial benefits reaching local residents. The potential for the development of nature tourism and handicraft based industry should thus be explored as a means of alternative livelihoods. This however, should not be developed as the only means of sustenance of families.

Some highly innovative nature tourism schemes are being developed for Ladakh by organizations such as the Snow Leopard Conservancy, The Mountain Institute along with local organizations

such as Ladakh Ecological Development Group (Jackson, Rodney and Jain Nandita, pers. comm.).

More effort needs to be devoted to establish optimal stocking densities for livestock in different parts of the range

Grazing competition between livestock and wild herbivores seems to be a significant conservation issue. However, quantitative information on impacts of this is grossly lacking from the region. The studies should also try to determine stocking densities that enable wildlife to exist at levels that allow them to breed and sustain a healthy population. These studies will be crucial for recommendations for the permitted grazing in the multiple-use areas.

Levels of perceived and actual conflict between wildlife and people need to be established

Data on actual levels of conflicts, the wildlife species involved and conflict 'hotspots' is often lacking from the region. For designing any conflict resolution scheme, such data is of immense importance. With such information, mitigation measures such as corral improvement, in small, but effective ways should then be taken up to resolve the issues (Jackson and Jain 1999). Innovative livestock insurance schemes are also an important possibility. These can be taken up in conjunction with programmes that help in actual reduction of the damage. One such scheme has been designed in Baltistan where the community managed insurance funds are complemented by money generated through wildlife tourism (Hussain 2000). Another one is being formulated in Kibber wildlife sanctuary, Himachal Pradesh, India by the Nature Conservation Foundation-ISLT. Resolving conflicts effectively will have a two pronged benefit. One is that the monetary loss to the local herders will be reduced and second is that they will be more sensitive to conservation efforts.

Conservation awareness initiatives

Conservation awareness initiatives that illustrate the peculiarities and fragility of the local environment need to be taken up for the local people, tourists and importantly, the district Government officials and politicians. For the latter these may be in the form of relevant directions from various Central Ministries for keeping wildlife conservation perspective in view when developing conservation schemes.

Proactive policies and guidelines from the Wildlife Department

The Wildlife Department, in collaboration with scientific organizations needs to develop Management Plans for the existing PAs with relevant zonations in place. All other potential areas that could serve as the revised 'Core Zones' need to be surveyed immediately. Issues relating to infrastructure need to be addressed to the Ministry of Environment and Forests. The revival and redrafting of the 'Snow Leopard Scheme' (Anon. 1988) could be an ideal opportunity to bring in the suggested changes in the conservation of the region.

The Wildlife Institute of India, Dehradun, along with its partners, the International Snow Leopard Trust and the US Fish and Wildlife Service have already undertaken a step in the direction of generating information on the gap areas and also conservation efforts that enable better trained staff with sound management plans in place. The programme also intends to try and influence policy for conservation in the region (Anon. 2001).

Conclusions

The above mentioned is an indicative approach of reconciling conservation concerns with development planning that would lead to improved standards of living through increased employment, better education, increased agricultural returns, increased value for livestock products, and also increased ecotourism and wildlife viewing. Use of conflict alleviation measures would help build trust between conservation and local herders. These will constitute important steps towards providing suitable alternatives to people and enable them to give up the areas to be used as the small 'core zones'. The strategy would also reduce livestock grazing pressures in some areas; reduce human-wildlife conflicts, and, hopefully, lead to the revival of wildlife in most areas in a manner that is more acceptable to the local people, politicians and conservationists alike. Undoubtedly, a regional perspective for conservation and development cannot be developed overnight. What is however needed is a beginning of planning, integrating and implementing of a wide array of conservation measures, based on an understanding of the ecology, environment and developmental needs of the Indian Trans-Himalaya, which is a vast landscape with unique biodiversity.

It would also be essential to revive the 'Project Snow Leopard' to deal with the regional planning issue by evolving a framework for conservation and development in a participatory manner. The urgency of reviving the 'Project Snow Leopard' cannot be overemphasized given the conservation challenges facing the vast Trans-Himalayan landscape and the crisis for survival of snow leopard – the flagship species of the region.

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Appendix 1

Large mammals of the Indian Trans-Himalaya along with their legal conservation status

Species	Scientific Name	Indian Wildlife Protection Act 1972	IUCN Category (CAMP Workshop – Anon 1998b)
Ungulates			
Siberian ibex	*Capra ibex sibirica*	I	*Vulnerable*
Tibetan argali	*Ovis ammon hodgsoni*	I	Critical
Ladakh urial	*Ovis orientalis vignii*	I	Endangered
Bharal	*Pseudois nayaur*	I	Low Risk
Tibetan antelope	*Pantholops hodgsoni*	I	Critical
Tibetan gazelle	*Procapra picticaudata*	I	Critical
Tibetan wild ass	*Equus kiang*	I	Vulnerable
Wild yak	*Bos grunniens*	I	Critical
Large carnivores			
Snow leopard	*Uncia uncia*	I	Endangered
Lynx	*Lynx isabellina*	I	?
Tibetan wolf	*Canis lupus chanko*	I	Vulnerable
Wild dog	*Cuon alpinus*	?	Critical
Red fox	*Vulpus vulpus*	?	Low Risk
Brown bear	*Ursus arctos*	I	Low Risk

Chapter 11

Why the Mountains?

M.K.Ranjit Sinh

Ever so often I am asked as to why I have a special predilection for montane fauna.

Firstly, the Indian subcontinent has montane mammals unparalleled in the world for their variety, diversity size and splendour. They have been the least studied, indeed least known for the remoteness of their habitats. Amongst them are species gravely threatened, but there are no godfathers to mountain animals, not even for the snowleopard or the stately Hangul. Of all the terrestrial regions, the mountains are the most difficult to police and protect from the poacher and they are also the most fragile. Yet, next to the hot deserts, of all our terrestrial biomes the mountains and uplands find the least representation is our protected areas system, despite the fact that they provide the most precious commodity in our country: potable water.

But there is another reason for the mountain preference. I have always been fascinated by mountains, but I will not climb them just for the sake of climbing. I will do so if I can see an animal. And in the pursuit of these animals, I have travelled and climbed the Himalayas from the Kaj-i-Nag in western Kashmir to Walong and beyond in Arunanchal in the east. I have been rewarded with some of the most treasured days of my life. It is just not the backdrop alone - and could there be a more magnificent backdrop than those of the Himalayan snows and peaks and of the Nilgiri Sholas - but the animals themselves. A great 50 inch-homed markhor statuesquely pivoted on a pinnacle, immobile except for the wafting of his cape of long hair in the strong mountain breeze; Ibex with horns almost full circle, silhouetted against a turquoise - blue sky; a hundred *Ovis ammon*. the largest bodied sheep in the world festooned over a stark - barren hillside; a superb specimen of a snow leopard stalking bharal over shale in the bright winter-moming sun; a fourteen-point hangul stag, head raised heavenward, the rising crescendo of his rutting call drowning the gentle murmer of the Harwan stream, all around the landscape draped in autumn hues, russet, copper, gold and sombre green.

There is yet another reason. Man turns to nature for two basic needs - to escape the confines of communal living and to have communion with nature. While occupied with your favourite pastime of watching animals in of our parks or sanctuaries, how many times you must have frowned with disapproval when another vehicle drove up, or when you realize that you are not alone in the jungle? Not so in the mountains. You have your animal and your ambience all to yourself in the mountains. Selfish perhaps, but how deliciously satisfying and rejuvenating. One has *lebensraum* - living space - uncluttered. And there are no shortcuts in the mountains - no driving up in jeeps, no hides at waterholes, no boat rides. When you look at a picture taken by you of a shapu or a Himalayan tahr, you remember the long stiff climb, lungs

abursting, and the benumbing cold. It is not just a photograph, but the reliving of a vivid experience. Only those who have savoured this elixir and have the gumption and the physique to crave for more, would understand and appreciate this.

My first long trek in the Himalayas was way back in 1958 when I was still in college. The flight from Srinagar to Leh was in a propeller driven DC 2 plane, barely going over the 10,000' ZojiLa and then dipping down, the entire route flanked by awesome mountains towering above. There was only one jeep in Ladakh west of Kargil and that was with the commanding officer of the Qnly. Battalion in that area. And there were just 2 roads - one from the gravel air-strip to the old Moravian Mission which constituted the battalion HQ and where we stayed, and the other from Leh to Hemis Gompa some 22 km away. The last caravan from Yarkand had come in over the Karakoram Pass a year earlier and its wares were available for sale. But there were only 2 tins of kerosene available in the market, and which we bought. In the countryside the Rupee had little value and we bought our supplies of eggs and the delicious hair - entwined yak-milk butter on a barter basis. We walked from Leh to Upshi, ferrying ourselves over the Indus over a rope as the makeshift bridge had been washed away. Then up the spectacularly awesome Upshi Gorge, past Gya, up Kiamer Nala and the *Ovis ammon* grounds, over Kiamer La and to Tso Kar, where we saw our first Tibetan Gazelle, grey wolf and Tibetan sandgrouse. On the Tso Kar, bar-headed geese were breeding, as were brahminy duck in their deep russet-red plumage. Then over the 17600', Taglang La and down to Hemis for the annual fair and Lama dance, the festival of the year for Ladakh. I was surprised by the number of animals and birds to be encountered and even more by their lameness. The last hunting expeditions, all by Englishmen - were before World War II. The locals were Buddhists and the army had not penetrated beyond Leh. We had chakor amongst our camp and bharal above it - Shapu were still around on the vast sandy plains. Amongst all the shrill trumpeting of the monastic horns and clashing of cymbals, the din and chang-swilling at the Hemis festival, I remember looking up at the mountain above and seeing a herd of bharal peaceably munching. It was a month of marching in pure paradise.

I next went to Ladakh in 1970. What a change, what progress! One could drive from Leh to Hanie or Demchok in a day, a distance of over 250 kms, or go over Fotu Za to Kargil and even over the mighty Khardong La, the highest pass in the world traversable by motor vehicles. But wither wildlife? Gone were the bharal, the shapu and the chakor in the Indus valley and the Kiang would lit out on seeing one's vehicle. I have traveled thrice more through Ladakh. The armed forces are not the prime enemies of wildlife that they used to be. The Kiang do not spook so much and animals can be seen off the roads, though never in great numbers. Tibetan sandgrouse still come to sip water at the rivulets that empty into Tso Kar, though the gazelle have gone from this area. But there is now a *Shiv mandir* at Tso Kar, looking forlorn and totally out of place. Why do we need another Shiv temple when the entire Himalaya is a Shivalaya?

In 1960, I went to the Niligiris for the first time. We walked to Bison Shola and Nadgami Peak from Emerald. En route there were tracks of tiger and we saw

sambar, bison, barking deer and elephant. In days to come we camped on some exquisite sites and saw a black leopard and Niligiri tahr, I suspect I also saw a Malabar civet, the rarest among the rare. From the lip of the kundah escarpment we looked down upon Silent Valley and its surrounds - miles upon miles of unbroken canopied forest of bewildering hues. I have never in my life seen such pristine, verdure jungle, shola, crags and grassland. And I never saw a vestige of human presence except for the few footpaths, surrounded though we were by some of the densest human habitations in the world. Now the Forest Department has planted eucalyptus in the grassland, denying the tahr of grazing and providing the leopard cover to stalk the tahr. Are there not other places to plant gum trees?

In no mountains of the world have I found man and nature in such harmony and equilibrium as in Bhutan. When I first trekked there in 1965 there were no forestry operations, hardly any roads beyond Thimpu and Paro and mountain animals and birds were so unbelievably fearless of man. Musk deer and snow partridge would allow human approach to within 20 metres. Herds of bharal would allow our yak caravan to pass by within 200 metres and even takin would mill around on seeing humans, not depart. Quietly padding amongst some stunted junipers, I rounded a tree and came upon a male satyr tragopan in bright morning sunlight, resplendent in red, barely 5 metres away. Both the bird and I froze, he cocking his head slightly to survey me. Both watched each other for three or more minutes. Then the bird relaxed and started feeding! Perhaps it had never seen a human before.

For the long-term survival of our wildlife and wilderness we need popular support. That can only be forthcoming if there is mass appeal and appreciation, which in turn can only occur if people visit the areas and enjoy nature and the animate life. It won't happen in the mountains if the people go there only for pilgrimage to the mountain shrines and never undertake the arduous exercise to climb in order to see the animals. We need our armchair conservationists. We need bucket-seat (jeep driven) conservationists more. But most of all we need conservationists who do their work on their feet - and take no shortcuts.

Chapter 12
My Experiences with Mountain Ungulates in India

A.J.T.Johnsingh

As a boy, I started reading and enjoying Jim Corbett's stories on man-eating tigers and leopards. One of the narrations I particularly liked was an episode in 'The Man-eaters of Kumaon', which describes the hunting of goral, when Corbett was on the trail of the Champawat man-eater. While camping in Pati village (Pali according to Corbett), he asked the villagers whether he could be led to goral, promising to take one for his camp and two for the village. Three men from the village readily agreed and took the hunter to a ridge where goral were said to be plentiful. On reaching the base of the ridge, Corbett and his men sat under a tree, quietly watching the slope. Soon, a movement nearly 200 m up the ridge attracted his attention. It turned out to be a goral watching them. Corbett lay down, held his rifle against the root of an oak tree, took aim at the white throat of the goral, and fired from an uncomfortable angle. The villagers saw no movement on the slope and concluded that Corbett had mistakenly shot at a dry bush. Moments later, a goral materialised from out of the cover and started sliding and rolling downward. This disturbed two more goral, which jumped over the bushes, stood still for a few seconds, sounding their characteristic wheezing alarm, and ran rapidly along the slope. Corbett swiftly shot them down one after the other. All three goral rolled down and reached the tree where the party had been sitting. The villagers were so impressed by this performance that they later spread the story that Corbett's magic bullet not only killed the hidden goral but also brought them to the place where he was waiting. Instantly, Corbett became a hero and won the confidence of the villagers who thereafter willingly followed him in the man-eater terrain.

Interesting information on the goral emerges from this narration. They live in small groups, rest under cover in the noon heat, and when alarmed, run for a short distance before standing still to sound the alarm. In March 1985, when I joined the Wildlife Institute of India, one of my immediate desires was to see a goral in its natural habitat. The opportunity arose in December 1986, when I was camping in Dholkhand in the Rajaji National Park (NP), very close to the Institute. One morning, I suggested to my colleague Dr. G.S. Rawat, a man with immense experience in the Himalaya, that we should explore the high ridge in front of Dholkhand forest bungalow, which to me looked like a perfect goral habitat. We clambered up the slope, and within two hours saw five goral. Soon we decided to initiate a private study on goral in the Park during weekends and on other holidays. When we explained our ideas to Dr. S.P. Goyal, another colleague, who before joining the Institute had climbed only the sand dunes of Thar desert, willingly decided to join us, and we began working as a team. We named the area 'Goral Ridge'.

The goral is a stocky goat-like animal 65 to 70 cm at the shoulder and 20 to 25 kg in weight. Both sexes have horns and a conspicuous white throat patch. It is difficult to distinguish between the sexes from a distance. There are, however, some differences in their horns. The male's horns are thicker at the base, and when viewed from the front, more divergent than those of females. Taxonomists have placed the goral in a group popularly known as 'goat-antelopes' (Tribe *Rupicaprini*), said to be the common ancestor of both goats and sheep. The tribe seems to have an Asian origin. *Pachygazella grangeri* of the Pliocene, which is about 10 million years old, found in fossil deposits in China, was the probable ancestor of the rupicaprines. The *Rupicaprini* once had an extensive distribution in Eurasia and possibly in Africa. For example, a large goral, *Gallogoral meneghinii*, lived in the past in areas around present day Italy. Living relatives of goral are serow, *Nemorhaedus sumatraensis*, of south-east Asia, Taiwan and Japan; Rocky Mountain goat, *Oreamnos americanus*, of North America; and chamois, *Rupicapra rupicapra*, of Europe.

Goral has a wide distribution, from the Indus Kohistan region in Pakistan in the western Himalaya, across the eastern Himalaya, Myanmar, Thailand, China and in a few scattered areas in South Korea, North Korea, eastern Russia and the adjoining regions of China. Along this arc, which is discontinuous now, there are several species and subspecies. Within the Himalayan region of the Indian subcontinent, there are three species: the Himalayan goral (*Nemorhaedus goral,* with two subspecies: grey goral *N.g.bedfordi* in the western Himalaya, and brown goral *N.g.goral* in the eastern Himalaya), Evan's long-tailed goral (*N. caudatus evansi* in Nagaland and possibly in Assam) and Burmese red goral (*N. baileyi cranbrooki* in north-east Arunachal Pradesh). Both Evan's long-tailed goral and Burmese red goral are found in Myanmar. Thailand has one species (Evan's long-tailed goral). China has four subspecies: Chinese long-tailed goral (*N.c.caudatus)* Tibetan red goral *N. baileyi baileyi*, Grey long-tailed goral *(N.c.griseus)* and Korean or Amur long-tailed goral (*N. c. raddeanus*). Amur goral occurs in North Korea, South Korea and the Russian montane forests along the border with China and the coastal cliffs overlooking the sea of Japan.

In India, goral is found in the Himalaya and Shivaliks of Kashmir, Himachal Pradesh, Uttaranchal (part of former Uttar Pradesh), Sikkim, West Bengal and Arunachal Pradesh. Goral is also reported to occur in the state of Nagaland and Assam. They prefer varying altitudes, from 200 m in the Uttaranchal Shivaliks, to 4000 m in the Garhwal Himalayas. There could be 100,000 goral in the Indian Himalaya. The action plan for Caprinae, compiled by the World Conservation Union (IUCN), reports that poaching is the single major problem threatening goral throughout its range.

Our research resulted in the collection of much new data on this hitherto little known species. Goral are primarily grazers, although they feed upon tender shoots of certain shrubs and herbs when available. On the Goral Ridge, we observed that when langur (*Semnopithecus entellus*) were feeding up in the trees, the goral tended to group below, feeding on fallen leaves, flowers and fruits. We have also seen sambar (*Cervus unicolor*), chital (*Axis axis*) and barking deer (*Muntiacus muntjak*) join

goral in such situations. On rainy days, goral can be seen throughout the day. In winter, however, there appears to be a morning and evening peak in feeding. The animals tend to rest for the remaining part of the day, and if the weather is cool, they may be seen basking. In summer, goral retreat into cover as early as 0730 hrs, emerging only late in the evening when the heat has died down. When thirsty, they will, nevertheless, visit waterholes even in the heat of the noonday sun, usually choosing a water source close to steep ridges.

Approximately 60% of our goral sightings were of solitary animals, or of females accompanied by a yearling and/or a kid. The largest group comprised seven animals, which rested on a gentle slope after feeding on the lush grass of the monsoon. We frequently came across the pugmarks of leopard and tiger on the Goral Ridge. Analysis of tiger scats (droppings) indicated that the large but agile tiger does occasionally prey on the nimble-footed goral.

From what we gathered, based on walking transects, and wanderings over the hilly tract of Rajaji NP, which is around 300 km^2, we estimated that there could be about 1,000 goral in the Park. The Ganga River, however, divides the population. West of Ganga River the best concentrations appeared to be in two areas, the Dholkhand and the Bom Dhera ridges. Both areas are free from cattle grazing and lopping, a scourge all through the Park. Both locations also have water in the valley, even in summer, but they suffer the problem of *bhabar* grass (*Euliopsis binata*) cutting by villagers in winter. Fortunately, poaching is not a major problem here, a fact that is reflected in the high density of sambar and barking deer.

One benefit of cutting the grass in winter is the increased availability of protein-rich tender grasses in summer, a boon to ungulates. Probably the Shivalik habitat could do with some form of resource manipulation, like controlled burning of grasses, in order to provide more nutritious food in summer, leading to a higher density of wild ungulates. Grass cutting by villagers, which seems to be uncontrollable has two conservation problems. One is stealing of predator kills by the grass cutters all through the winter, and the other the erosion caused in the fragile Shivaliks by the rolling of grass bundles from hilltops. Grass cutting, along with other disturbances such as cattle grazing and poaching, can gradually lead to the decline of prey and predators, and therefore should be stopped at any cost. Our studies in Rajaji NP inspired two of our students, Charudutt Mishra and Anand Pendharkar, both nimble-footed like goral, to take up research on this mountain goat for their M.Sc. dissertation. Charu carried out his study in Majahtal Wildlife Sanctuary, and Anand in Simbalbara Wildlife Sanctuary (both in Himachal Pradesh) and the adjacent Darpur Reserved forest in Haryana. Charu found that goral fed almost entirely on grass. In his study area, goral preferred open, steep habitats with good grass cover, and avoided shrub-rich patches, particularly those areas where the shrub height exceeded their shoulder height. Anand observed that goral were not particularly social. Females were comparatively more social, and males associated with female groups only during the breeding period (November).

By now, the interest in the mountain ungulates, that had originated with goral,

had expanded to the entire group of wild sheep and goats – collectively grouped in the sub-family caprinae. This led to further work on these beautiful, nimble footed creatures in the high Himalaya and the cold deserts beyond.

During the years 1989 to 1991, Drs. S.N.Prasad, G.S.Rawat and I were Investigators of the research project 'Habitat ecology of mountain ungulates in Kedarnath Wildlife Sanctuary'. S.Sathyakumar worked as a Research Fellow in this project that involved studying mountain ungulates such as the musk deer, Himalayan tahr, serow and goral. I still remember very vividly the goral sightings we had in the Pine forests near Mandal, the sighting of the elusive serow in Shokharkh, and the trek to Madh Maheshwar during which we sighted several Himalayan tahr. This study developed suitable methods for abundance estimation and monitoring of these mountain ungulates and their habitat ecology.

In 1991, I initiated a study with Dr Michael Stüwe of the Smithsonian Institution, USA and my colleagues Dr G.S. Rawat and S.N. Prasad on the ecology of the Siberian ibex, a true goat inhabiting the rugged Trans-Himalayan mountains from Himachal Pradesh in India, through Ladakh, PoK, and in the Central Asian mountains. We hired two of our alumni from our Masters programme, Nima Manjrekar and Yash Veer Bhatnagar who studied the species in arduous conditions for over 5 years. We managed to radio-collar seven ibex with the help of our institute veterinarian, Dr. P.K. Malik, and the researchers were able to obtain some hitherto unknown facts about the ranging of the species.

Having read through accounts on goral, I realized that so far, few good pictures of this species have been taken in the wild. Therefore, I took it as a challenge to take a good photograph of goral using the immensely satisfying traditional method, hiding and waiting in an appropriate location. As a result of my intensive and extensive wanderings and observations, I discovered two places which offered the potential for photography. One is the ridge top opposite the Dholkhand forest bungalow, and the other, two small watering points in a valley, about 8-km from Chilla on the Chilla-Laldhang road east of Ganga River. Over my long years of field research, I have discovered that animals seldom see people if they remain hidden in trees, and to me, waiting in the trees was much more exciting than remaining hidden in a ground hide! Therefore, in the valley habitat, I made a simple hide up in a *Mallotus philippinensis* tree, hardly 15-m from a slushy area near a natural salt lick, which was frequented by goral during the hot hours in summer. I have taken some good pictures sitting in this tree hide, and recorded some interesting observations on the behaviour of goral.

However, I got more pleasure from waiting and photographing goral from two small trees on the top of Goral Ridge. In the course of time, I realized that photography was possible only in summer, late in the evening, when goral left the cool cover of the valley habitat and came to the ridge top to feed. This, however, necessitated a steep climb at around 1400 hrs, when it was exceedingly hot. One *Ougeinia oojeinensis* tree at the edge of the ridge top, and the other a *Grewia elastica* tree about 10 m away, near a trail frequently used by goral, gave me the necessary hideouts on the ridge top. I found it scary to sit on the *O. oojeinensis* tree, as it

swayed even in the light wind. I was afraid that a heavy wind might uproot the tree, and a straight fall of 50 m or so would make my wildlife adventure a fatal accident. Once when I sat on this tree, a female goral came right under me and started feeding on the leaves that I had plucked and thrown down, to have the necessary visibility around (the leaf of *O. oojeinensis*, a leguminous species, is reported to be highly nutritious). I could have easily jumped on to the back of the goral 3 m below! In spite of these close encounters, I eventually gave up sitting on this tree.

One of my visits to the *Grewia elastica* tree is worth recording. It was the time when there were reports of terrorists from Punjab spilling into the confines of Rajaji NP. The temperature soared over 40ºC as I made my way up the ridge. The oppressive heat and the steep climb forced me to stop every 50 m or so. On my way up, while passing a dense patch of *Bauhinia vahlii* along the ridge, I flushed two goral resting in the shade. A short while later, a sambar doe with a yearling hind and a fawn, resting in the scanty shade of trees, ran out of the cover and went up the hill. By the time I settled down in my hide amidst the foliage, it was around 1500 hrs. An eerie silence enveloped me. The air was still and not a leaf rustled.

When the sun began to set, I noticed a palpable change in the mood of the jungle. A steady cool breeze made the branches dance. And several animals seemed to waken from their slumber. A group of sambar and even an elephant bull appeared out of nowhere, and began to feed on the valley vegetation. The alarm calls of chital, sambar and barking deer all around the ridge indicated that the time had come for predators to get on the move. I even heard the distinct footsteps of a goral on the dry leaf litter as it slowly made its way up from its resting site through the forest, towards the grass-covered slope, which I faced. It was a male, and he fed peacefully on the tender shoots of the understorey vegetation. When he reached the grassy strip, he began to gorge on the green leaves of a bamboo-like grass, *Neyraudia arundinacea*, and the sprouting shoots of *bhabar* grass. I sat without any movement amidst the foliage and allowed him to approach within five metres of me, and surprised him by taking a photograph. The sound of the camera startled him, and he ran away from me, leaping effortlessly 20 m down the steep slope. He then stood looking in my direction, stamping his forefoot and whistling his alarm to the jungle at large. I froze till he slowly and nervously resumed feeding.

When the sun touched the horizon, I decided to leave. As I started out, I thought to myself that if there were no elephants on the way, it would take me around 40 minutes to reach the Dholkhand forest bungalow. I did not worry much about elephants, as I was confident of avoiding them if I encountered them on the path. I found it ironical that of all the imagined dangers of the wilds, the ones I feared the most were from my own species, the terrorists from Punjab. I am glad that the terror has now become a bad memory of the past, and I wish Rajaji NP, with its exquisite wildlife and enchanting goral habitats, will remain a safe haven for wildlifers to wander, wait, photograph and enjoy wildlife. For the goral, I wish that a much stricter control on poaching be put in place, and patches of its habitat should be protected from all forms of disturbance to enable this interesting species to survive in its exciting habitats across its distributional range.

Chapter 13

A Post-Modern Introduction To Wildlife In The Indian Trans-Himalaya

J.L. Fox

The stories of William Stockley, Kinloch and other travelers of a century or more ago painted a romantic view of the hunting adventures and wildlife species encountered in the highlands of central Asia and Trans-Himalaya. The world has changed dramatically since those days and my own experience has been a curious mixture that could be termed a "post-modern" traveler's glimpse of and the initiation of a conservation movement in the trans-Himalaya – actually, just some occasional views of these changes through a foreigner's eyes. Following the exploits of the British and other western hunters in the last century various military actions coupled with general increases in road access and firearm technology have rendered the widespread wildlife but a remnant of its former abundance. Species of the most inaccessible areas, such as blue sheep and in places ibex, probably did not have significant population reductions in those sites. But others such as the Ladakh urial, Tibetan gazelle, Tibetan argali were heavily hunted. Today, with hunting restrictions, we are apparently seeing a recovery of some of these wild ungulate populations, for example the Ladakh urial along the Indus and both blue sheep and ibex in accessible parts of their range, as well as the return of a few gazelle in eastern Ladakh. But in general for ungulates of the open highlands, a modernising animal husbandry leaves little room for species of the plains and open hills (such as gazelle, argali, wild yak). The conservation of these will require significant commitment on the part of government and conservation organisations in partnership with local communities. Attitudes towards these wild ungulate species have begun to change over the course of 30 years since I first began working in the Himalayan region.

During the summer of 1974, I was on vacation in the Kashmir valley, after a couple years working with Nepal's National Parks Department, when suddenly the northern region of Ladakh opened to foreign visitors. I quickly arranged a trip to Leh and its surroundings. Mr. A.R.Wani, then an officer in the Wildlife Department in Srinagar had just provided me the necessary permits and advice for a short fishing trip I took to lakes above Sonamarg, and he now helped arrange for me to meet with Mr. Desh Paul, the Wildlife Range Officer in Leh. Desh Paul was still overseeing what was essentially a series of trans-Himalayan hunting reserves originally designated by the British, and he took pride in noting when the last argali or ibex were taken by a foreign hunter in the different reserves. Over many glasses of *chang* in his house in Leh, Desh Paul and I discussed at length the distribution and abundance of the various *ridaks* or mountain wildlife of Ladakh.Guided by local forest officers, I

took some short hikes in the mountains around Leh; I had my first taste of the central Asian highlands.

It took some time, during which I completed graduate training at universities in the US, but a little over 10 years later I had the good fortune to participate in a snow leopard survey project with the Wildlife Institute of India (WII) that involved extensive travel in India's three northwestern Himalayan states and a solid introduction to the wild ungulates of the region. That short trip to Ladakh in 1974 presaged a long involvement with wildlife research and conservation in the region, and today, as I begin to write this in Dehra Dun, WII is embarking on a new collaborative program with my university in Norway to further investigate and provide a foundation for conservation of India's mountain ungulates.

Snow leopard survey project : I remember especially vividly the arrival at our first camp for the survey project in Ladakh. After a late start from Srinagar one mid-November day we drove through the night past Kargil and up the Suru valley, finally past midnight searching for the selected site at about 4,000 m in the valley, rustling up several foxes and hares in the vehicle lights before finally settling in near a small village on a wide portion of the alluvial flats of the upper valley. The next day we drove with WII Director Mr. H.S. Panwar up to the end of the Suru valley at Pensila Pass to have a look into Zanskar proper. Now on we were left to our own devices at our basecamp near the village of Zulidok. Sathya Sinha, Raghu Chundawat, Palav Das and myself were to spend the next 9-months surveying northern Jammu & Kashmir, Uttar Pradesh and Himachal Pradesh for the snow leopard and its prey. The field camp we had searched for on the first night was a recently constructed PWD rest house, which unfortunately did not provide the best start to life in the high trans-Himalaya. We had brought with us several kerosene burning *bukhari* stoves for heating, but with the strong winds in the valley blowing down the smoke pipes, the stoves would constantly "backfire" and fill up our rooms with thick black kerosene smoke that sorely tested one's breathing ability at that elevation. So we would have to air out the place and be back to freezing temperatures again; not a pleasant task in the middle of the night. The living conditions there were quite uncomfortable, but we did get our first look at fresh snow leopard sign (tracks in the snow) and could observe herds of ibex every day. In the Ichoo nallah behind our camp we could observe a good population of nearly a hundred ibex, and by the time we left were treated each morning to the displays of rutting ibex on the slopes just adjacent to our camp. We stayed in Zulidok until the second half of December, when after the first heavy snowfall of the season, we plowed our way down-valley through the snow to be met near Panamik by Alok Chandola, who was co-ordinating the logistics for our surveys, and who had trekked up through the snow some distance to meet us.

From there, we were moved off by Chandola and his crew in COLD airy jeeps to the drier and less snow-covered Leh district, we found more suitable conditions for searching the wild ungulates and their predator the snow leopard. Mr. Chering Nurbu, Wildlife Range officer at that time in Leh, took us to the Shang valley, arranged a daring January crossing for us of the Kongmaru pass into the upper Markha valley, where we saw several hundred bharal or blue sheep and a few

more "very recent" signs of snow leopard, as well as signs of wolf and lynx. Subsequently, I was fortunate enough to take several journeys in the mountains with Mr. Nurbu and learned much from his extensive knowledge of Ladakhi wildlife in his enjoyable company.

But as we had still not seen one of these elusive snow leoaprds, we decided to try again among the abundant ibex of the upper Suru Valley, this time in February. Here Raghu Chundawat made his first valiant attempts at skiing. He has subsequently gotten a little more practice in Norway when we skied about 10 km into a field research cabin used as a base for studies on reindeer and their predators, but here we wanted to see if we could use these skis to travel around in the upper Suru valley in late winter when there is about 1 metre of snow on the ground. It quickly became clear that although we could negotiate the deep snowpack on our skis, any attempt to have local help in portering up needed supplies along the snow-covered trail was not practical. We abandoned our ski journey and returned to Leh. We immediately left for the Markha valley and were rewarded with our first snow leopard sighting within just a few days. At a seasonal grazing site known as Chaluk, we came across two young girls herding their goats and sheep, and observed a snow leopard kill several of their stock. Although these cats depend primarily on the abundant bharal in this area, snow leopards do take some livestock, especially during winter.

We concluded that the central Ladakh areas of the Zanskar range held the best snow leopard populations of all the areas we visited throughout northwest India. One such site, in the Rumbak catchment just southwest of Leh, was chosen for continued work, from which Raghu Chundawat eventually received his PhD. Raghu has gone on to distinguish himself in the study of tigers in central India, but retains a keen interest and actively supports conservation in the trans-Himalaya. In the meantime a new crop of young biologists at WII and elsewhere has been inspired by this early work and studies on many aspects of wildlife and ecology have been initiated there. It has also been a pleasure to see others at WII become interested in the high Himalaya and trans-Himalaya. And with support from the US Fish and Wildlife Service and the International Snow Leopard Trust various WII faculty are endeavouring to survey a wide variety of flora and fauna and flora, thus beginning to flesh out a comprehensive view of biodiversity for Ladakh.

Today, I have the pleasure of continuing to work with both veterans and new-comers at WII in some co-operative initiatives in the mountains. Through a generous educational grant program in Norway, I was able to support the graduate education of the first Ladakhi masters student in wildlife ecology, Mr. Tsewang Namgail, who will continue to work with our co-operative program as he prepares for bigger things. Norway, through its NORAD-funded international institutional co-operation program, has just begun supporting the formalisation of continued research co-operation between my university and WII in high Himalayan and Trans-Himalayan wildlife research and conservation. And I look forward to see even more students and faculty develop an interest in the mountain regions.

India has designated a number of wildlife sanctuaries in the trans-Himalayan region of Ladakh. The area is developing rapidly,

tourism is becoming an important industry, and a modernisation of livestock husbandry is underway. Wild species of the high open rangelands will be most affected by these developments. If conservation of the wild ungulates, their predators and other species is to be a serious goal for India in this region, then appropriate measures needs to be taken. At least in some areas of the high plains, application of tourist interest in Tibetan plateau ecosystems and wildlife, coupled with livestock development interventions appropriate to wildlife conservation can be a key to reaching this goal. We hope to help our bit in the provision of a research-based foundation for these conservation initiatives.

Chapter 14

My Memoir of the Wildlife Surveys in Ladakh

D.P. Mallon

In 1980, there was only limited recent information on the ecology of Ladakh. Much of what was known was derived from old accounts, often detailing the depredations of British hunters. These accounts mainly referred to locations along the main route from Srinagar to Leh, and then upstream along the Indus Valley and on to the high plains of Rupshu in eastern Ladakh, where the most sought-after Tibetan species could be found (wild yak, Tibetan antelope, Tibetan gazelle, Tibetan argali). Although some recent information had been accumulated by the Department of Wildlife Protection, large areas had not been investigated in any detail. The most obvious gaps lay in the mountains between the south side of the Indus and the main Himalayan Range. In late 1980, civilian flights between Delhi and Leh were extended into the winter period. These greatly facilitated access and meant it was no longer necessary to remain there from autumn to late spring when road passes were closed by snow.

The first priority was a survey of the status of the Ladakh urial or shapu, initiated in winter 1980-81 and carried out at the invitation of the then Chief Wildlife Warden of Jammu & Kashmir, Mir Inayet Ullah. This involved methodical surveys and interviews in all the side valleys of the Indus between Upshi and Kalste which comprised the main part of their former range in the area. The terrain here is undemanding and surveying was relatively easy, though the interviews proved more problematic at first. Local villagers did not understand why a foreigner should spend so much time trekking over the hills in the cold just to look for an animal. Many assumed I must have an ulterior motive, probably looking for gold. Old beliefs also still survived. On one occasion arriving in a settlement after dark, I could not get a response from any of the houses or find anywhere to stay, which was very unusual, and was forced to endure a cold bivouac on the hills. The next morning the local school teacher told me with great amusement that after dark people would not open their doors for fear of letting the *tsan* or bad spirits enter. The surveys found widespread but scattered small shapu populations surviving within the known range along the Indus Valley, the low numbers the legacy of illegal hunting. It is heartening to see that the population has now expanded to the extent described elsewhere in this volume.

Subsequent fieldwork involved wider baseline surveys of the mountains of Ladakh and Zanskar. The centre of the Zanskar Range consists of resistant sedimentary rocks that have been severely tilted and folded then incised by rivers leaving deep gorges. Progress through these is only possible in late summer and autumn when water levels fall. The gorge of the Zanskar river itself cuts right through the range and is impassable for 9-10 months of the year but it can be traversed in midwinter when the surface freezes due to the severe cold.

This ice route was utilised in four winter field visits to investigate all the side valleys between Markha and Zangla. Difficulties in moving around in the rugged terrain of the 'gorge zone' were initially compounded by route finding problems as GPS equipment was not available at the time and the only maps that could be obtained publicly were old Survey of India sheets at a 1:250,000 scale. Although these were based on surveys made in 1867-1926 and a number of settlements marked could not be found, most ridgelines and drainages were accurate and routes through the mountains were found with the help of sketch maps and route information from other trekking and mountaineering parties. One exception to the accuracy of the old maps was provided by the Tilat Chu. All my Zanskari guides said that this was the best place for snow leopards and other wildlife. They described it as a large tributary valley on the south side of the Zanskar Gorge and definitely situated above the Markha. The only possibility appeared to be a large unnamed north-south valley shown on the map just upstream of the Chang Chu. Two attempts to find this valley in consecutive winters failed and it became clear that no large side valley existed in that sector of the gorge. I then discovered that the Chang Chu (a major tributary mis-named the Khurna River on many maps) was actually called the Tilat Chu by the Zanskaris and the two were identical. Presumably the map makers, similarly confused had simply added in a second valley where they guessed it ought to be.

In attempting to cover such a large area, local information was vital. Some villagers could not distinguish between animal species or thought that male and female were different species, while others referred to all as *ridaks*, a generic Ladakhi term for mountain ungulate. So extreme was the faith in their own knowledge that some Zanskari guides called everything *skyin* (ibex) and completely refused to believe in the existence of bharal. Only when I took them to see a dead male bharal killed by a snow leopard and was able to show them its distinctive horns and black chest would they accept the occurrence of two species. Eventually a network of knowledgeable reliable informants was built up and they were able to contribute a lot of information In the course of more than 4300km of foot surveys all the main sub-catchments were visited, habitats recorded and the distribution of the larger mammals mapped. In addition, long treks into remote areas in the company of local people provided a wonderful opportunity to learn about their customs and way of life and to appreciate their skill in traversing the mountains. Apart from getting temporarily lost a couple of times and some nerve-wracking traverses on half paths over steep scree and cliffs 200-300 metres above the rivers, we had no real setbacks. In fact the greatest problems we encountered were both in villages. The first was in Kharnak, on the edge of Chang Tang plateau, where the dogs are so fierce and unfriendly that it was impossible to leave a tent for any reason, however personal, without being accompanied by a local person to stop them attacking. The second was realising that a cow was greedily eating my field notebook while I interviewed its owner, necessitating a struggle to pull the remainder out of its jaws before a whole weeks field notes disappeared forever.

The more remote parts of the range contain the largest remaining fragments of riverine woodland in the area. In the valley of the Chang Chu, there are dense

thickets of *Salix*, *Hippophae*, and *Populus* some of which are virtually impenetrable. Even rarer are small stands of Juniper (*Juniperus indica*) and Himalayan birch (*Betula utilis*) trees. In one or two side valleys, there are remnants of a type of open steppe woodland. The presence here of rufuos-naped tit (*Parus rufonuchalis*) a non-migratory passerine species, is evidently a relict from a period when dry open juniper extended more widely across the Trans-Himalaya. Elsewhere, riverine woodland has been incrementally removed over the centuries for building timber and fuel. Even in some remote areas it was incredible to find that a few people from remote villages such as Lingshet had travelled up the gorge in search of trees for use as building timber which they cut and man-hauled back for 2-3 days over the ice and up the valley to their home.

A relatively simple pattern of mountain ungulate distribution emerged. Shapu occur at lower elevations in a narrow band along the Indus and its tributaries, extending upstream along the Zanskar as far as the confluence and into the Markha Valley, with ibex and bharal distributed across the mountains of Ladakh and Zanskar south to the main Himalayan Range. Shapu habitat is characterised by open, relatively even terrain, much of which coincides with a band of ancient, well-weathered sedimentary rocks along the line of the Indus suture zone and is dominated by semidesert vegetation. Bharal and ibex prefer more rugged, broken terrain, with cliffs for escape, and both occur at much higher elevations.

Two characteristic Tibetan Plateau species also have very limited distributions in the central mountains. Kiang or Tibetan wild ass (*Equus kiang*) range from the high plains of eastern Ladakh into the Karnak area of the upper Chang Chu, and single animals sporadically wander farther west into nullahs of the upper Markha catchment. Tibetan argali (*Ovis ammon hodgsoni*), much scarcer than kiang, have established small outlying populations in the central mountains on at least three occasions during the nineteenth and twentieth centuries. One of these was reported in the 1880s at an unnamed locality south of the Indus, and another in the 1930s. The latest of these appeared in the late 1970s in the upper Rumbak valley and is still thriving (Fox *et al.* 1991).

Habitat separation between shapu on the one hand and bharal and ibex on the other is a typical example of that between wild sheep and goats. Of more interest are the distributions of bharal and ibex, with bharal occurring principally in the eastern parts of Ladakh and ibex in the west. The habitats they occupy are usually indistinguishable on a number of observed factors, such as solid geology, ruggedness, vegetation, altitudinal range, yet the geographical separation between the two species is quite clear-cut and there is little range overlap (perhaps 3-4% in Ladakh) along the contact zone. A few mixed groups of ibex and bharal have been reported in the Shun-Shadi area of Zanskar, but such occurrences are the exception rather than the rule and hybridisation has not been reported. This pattern of largely exclusive ranges, with a long contact zone is repeated elsewhere when the two species' ranges meet. Discussing the separate distributions of ibex and bharal in the Karakoram, Schaller (1977) observed: "Competition for resources would be inevitable and coexistence impossible without a

geographic partitioning of ranges. Sympatric survival is not possible in a simple habitat for caprids of a similar size". They have apparently partitioned the habitat geographically, reflecting dispersal from different directions: ibex from the west and bharal from the east. A similar zoogeographical pattern is repeated by other species pairs in Ladakh: marmots (*Marmota himalayensis* and *M. caudata*); hares (*Lepus oiostolus* and *L. capensis*); and snowcock (*Tetraogallus tibetanus* and *T. himalayensis*).

The two sheep species, shapu and argali, have generally separate distributions in Ladakh that just come into contact at the eastern edge of the mountains in the Gya-Miru area, and also in Rumbak valley, a tributary of the Indus. Hybrids between the two very occasionally result, with 3-4 specimens reportedly obtained during the last *ca.*140 years, one of them from the Rumbak area, from Miru and in the 1870s from an unspecified locality (Ward 1924; Mallon 1998).

The mountain ungulate community in Ladakh shows a typical Trans-Himalayan pattern. In Spiti, which lies southeast of Ladakh, bharal and ibex occur in separate ranges which just meet in the Kibber area, and argali appear sporadically via valley-head passes on the Tibetan border (Burrard, 1925; CADARI, 1996). The mountain ungulate fauna of Hunza in Pakistan occupied Kashmir, northwest of Ladakh, also matches that of Ladakh. Shapu are (or were) restricted to a narrow band along valley bottoms, ibex are widespread and occur at higher elevations up to the snow line, but have a separate range from bharal. Kiang occurs in northeastern Hunza and argali (in this case *O. ammon poloi*) occur on the fringes of the area around the Khunjerab and Kilik passes.

Mountain ungulate densities in Ladakh are not notably high, in comparison with other areas, and their significance lies much more in their extensive and unfragmented ranges and the fact that overall, populations for most species are not declining. This is in large part due to the lack of a hunting tradition among local people and traditional Buddhist disapproval of killing animals. The species that has suffered most through illegal hunting is the shapu, whose habitat, lying along the main Srinagar-Leh highway, is easily accessible. The narrow-linear pattern of distribution, with its high ratio of periphery to area also makes it susceptible to fragmentation because it is accessible at many points, and there is no remote central core to act as a population reservoir, unlike the case with bharal and ibex.

More importantly from a conservation point of view, the mountains of Ladakh and Zanskar are a stronghold for the endangered snow leopard, which also has a continuous range throughout the area. Snow leopard sign is most common across the 'gorge zone' of the central mountains, where high terrain ruggedness, prevalence of cliffs, secure prey base, and low levels of human disturbance provide excellent habitat. There are very few locations there where human settlement and agriculture are feasible, and over 3000km^2 of contiguous habitat in the Chang Chu catchment, Shun-Shadi, and similar areas east of the Zanskar River can be considered as de facto core zone of the Hemis National Park for conservation of the snow leopard and its prey. Closer to inhabited areas, snow

leopards may have a negative impact through attacks on livestock, particularly in winter. Local people accept some level of depredation as an inevitable hazard, and few precautions are taken. For example, dogs are often not taken onto the pastures with grazing flocks, unlike in eastern Ladakh where Changpa herdsmen are always accompanied by ferocious Tibetan mastiffs. Livestock corrals and ground-floor rooms where sheep and goats are kept at night are often in a poor state of repair, allowing snow leopards to gain entry and when multiple killings result, real economic hardship is caused. Retaliatory killing causes some mortality but snow leopards often are simply chased away, and direct persecution in the form of hunting or trapping appears to be rare. Every one of more than 350 local inhabitants interviewed had a more hostile attitude towards wolves and considered them a greater threat to their livestock than snow leopards. This sentiment is reflected in the presence of wolf traps, known as *shangdong*, near several villages. These are quite large, circular constructions made of stone, with an overlapping lip and built close to a bank. They are baited with a dead sheep or goat and a wolf, once it has entered by way of the bank, cannot get out and is stoned to death. The overlapping lip makes them very difficult for humans to get out of too, as I once found to my cost, have jumped in to look for wolf bones and had to be helped out by two highly amused guides.

There is no doubt that Ladakh has a key role in the conservation of Trans-Himalayan biodiversity. The factors most favourable to wildlife conservation are demographic patterns and traditional attitudes to hunting. The low human population is not distributed evenly, but clumped in major valleys at sites where cultivable land and water for irrigation coincide. The study area contains several tracts of rugged terrain unsuitable for settlement or agriculture which are thus available to act as reservoirs of wild animal species. Extensive and largely unfragmented populations of the major species still survive. Wildlife has shown a limited retreat from around main centres, but bharal, ibex, wolf and snow leopard maintain virtually continuous distributions across the study area, while shapu have increased. The current conservation situation is relatively favourable when compared to many other parts of the Himalayan region. Firstly, Ladakh does not have the acute hunting problem faced by many parts of the Himalayan region. Secondly, the Trans-Himalayan environment is not susceptible to the sudden degradation following deforestation that has devastated wide tracts of the monsoon Himalaya. However, it is still fragile and no-one knows to what extent increased exploitation of pastures and hill slopes can take place before irreversible damage occurs, with serious long-term consequences for ungulates and animal husbandry. A clear priority is an inter-disciplinary study on the interaction of land use and available natural resources, to assess the impact of current rates of grazing and shrub removal on the vegetation and on wild animal populations. An adequate legal framework exists and a good protected area network has been notified: the success of future conservation will depend on successful translation into effective action on the ground.

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Chapter 15

Musk Deer: A Story Of Himalayan Survival

M.J.B. Green

Inspired by mountains to study musk deer

Brought up in the East Africa, where I became enthralled by its 'big game', Mount Kenya was the first mountain that I ever set eyes on - often elusive but fleetingly glanced through the clouds. Those early childhood inspirations led me to the Himalaya, first in Nepal and later India. Here I took up the challenge of trying to match my skills and endurance with some of its little-known ungulates in order to understand their lifestyles and explore my fascination for large animals in such a demanding and stunningly beautiful environment.

It was in Nepal that I first saw a musk deer while wading through knee-high rhododendron scrub in the upper Langtang Valley. I watched her for over ten minutes as she fed from crustose lichens - a spectacular and memorable sighting of her perched on a rock, silhouetted at dusk against the pink 6,391 m fluted peak of Gang Chenpo. That was my only sighting of musk deer during a fifteen-month survey of Langtang National Park.

Elusive and solitary, like many mountain peaks, the musk deer is the most valuable flagship species of animal or plant to be found in the Himalaya: its musk[1], produced only by males[2], is worth up to four times its weight in gold (US $ 45,000 kg^{-}). Its value is reflected in the tremendous lengths that hunters will go to catch musk deer. It was in 1976, while trekking through the little frequented Larke Khola in Langtang National Park, that I encountered several kilometres of trap-lines where the rhododendron and other scrub had been cut to make one-metre high barricades of brushwood that ran from the river up the valley sides to the alpine pastures, intersected by others traversing the slopes. Snares[3] were set in openings through the barricades at 10-30 m intervals and, having removed 30 from along a 350 m stretch, I estimated there to be 100-600 snares /km^2 - more than enough, surely, to wipe out that musk deer population within a few years.

Most hunting is done by local hill people and, although they receive only a fraction of the international market price of musk, their revenue from one musk gland or pod

[1] Musk is a secretion used by adult males for scent-marking. Highly valued for its scent, fixative, and medicinal properties, it has been used in traditional medicines and perfumery from as far back as 3,500 BC. Traditionally it is obtained by killing the animal and removing the musk gland (25 g average weight), depicted here, but musk can be milked from live males, as practised in Chinese musk deer farms.

[2] Males can be distinguished from females by their canine tusks. These weapons are used in displays and fights between males, performing a similar function to the antlers of true deer.

[3] Snare set for musk deer, with brushwood barricade on either side. This form of hunting is indiscriminate, killing females and juveniles as well as other wildlife species.

can equate to their annual cash income. Just how the musk deer is able to able to survive such intense hunting pressures, while living in seemingly inhospitable environments and in competition with other mountain ungulates became more apparent during my subsequent three-year study (1979-81) of the Himalayan species (*Moschus chrysogaster*) in Kedarnath Wildlife Sanctuary[4].

The musk deer proved to be a particularly elusive animal to study, being small (body weight about 10 –13 kg) and solitary, and taking refuge in the dense undergrowth of montane forests and sub-alpine scrub during the daytime. This was reflected in my observations, limited to 151 sightings (totalling about 64 hours) or about one sighting for every 10 hours in the field. Most observations were made at night, with the aid of a nightscope, when musk deer often emerged from hiding to feed on the alpine pastures. Telemetry would have helped immensely but I was singularly unsuccessful in capturing any animals to fit radio-collars, despite trying the traditional brushwood barricade but fitted with box traps, stalking with a dart-gun and driving animals into nets. However, tracking in snow during winter provided information about home ranges and regular monitoring of latrines, sites where musk deer repeatedly defaecate, told me much about their means of communication. I also collected hundreds of samples of pellets to find out what musk deer eat.

Coping with hunters and natural predators

My observations confirmed that musk deer lead very solitary lives: only once did I ever encounter two when an older male, judging from its longer canines, was seen pursuing a younger one at night. They occupied adjacent territories and must have been engaged in a border dispute. The fact that I never saw females accompanied by their young, combined with the knowledge that the young become independent of their mothers by about six weeks, is further evidence of their solitary behaviour - a characteristic of small forest ruminants that rely on being inconspicuous to avoid predators. This becomes even more crucial in winter when snow blankets the ground layer of vegetation that otherwise typically affords good cover for musk deer. But in snow conditions they are adept at remaining concealed in rhododendron thickets during the day, not easily detected even by the trained eye. Once I followed the tracks of a female in deep soft snow to within 9 metres of where she lay under a bush in a gully without seeing her. The animal flushed only after I had unknowingly retreated from her sight, behind a rock.

Implicit with such solitary behaviour is the rapid onset of sexual maturity. Musk deer attain most of their adult body weight by six months and become sexually mature by 18 months of age. Females are

The study area, complete with a wooden hut built by the Uttar Pradesh Wildlife Preservation Organisation, is located just below Tungnath Temple in evergreen oak forest and birch-rhododendron scrub. It subsequently became a popular site for fieldwork and training with researchers, students and trainees of the Wildlife Institute of India.

capable of breeding in their first year and in the forest musk deer (*M. berezovskii*) and Siberian musk deer (*M. moschiferus*), but not the Himalayan species, the incidence of twins is higher than single births. Such reproductive strategies have undoubtedly enabled musk deer to combat the tremendous hunting pressures experienced over centuries.

Hunters use a variety of techniques to kill musk deer, which includes snaring and shooting, the latter sometimes aided by dogs. There is nothing within the musk deer's repertoire of anti-predator strategies to counter the use of brush barricades in conjunction with snares, unless the animal is able to learn to recognise the danger of snares, which seems particularly unlikely for a solitary species. But the musk deer's solitariness and ability to remain concealed, often in dense scrub on precipitous terrain, equip it with some chance of evading hunters with guns.

Musk deer usually take flight when approached to within 30 metres but often then stop in their tracks to look back and, presumably, take stock of their situation. While this trait may help prevent animals being attacked by natural predators, it does provide the hunter with an extra chance of a shot. In snow conditions, however, musk deer have a considerable advantage over both hunters and natural predators: it's dew claws are enlarged, helping to spread its body weight over a larger surface area and thereby minimising sinking in soft snow. Wading knee-deep through snow, I found that musk deer never sank more than 26 cm and usually only about half this depth.

Natural predators in the Tungnath study area include both common and snow leopard (*Panthera pardus* and *P. uncia*), fox (*Vulpes vulpes*) and Himalayan yellow-throated marten (*Martes flavigula*). The hair and hoof remains of musk deer were found in leopard and fox scats but none of 12 scats of martens. However, there were two instances of juvenile musk deer being attacked by martens, which more often than not were seen hunting in pairs and small family groups. Leopard and snow leopard were both seen in the study area but it was impossible to differentiate between their scats.

I shall never forget my sighting of a snow leopard in March 1979. My attention having been attracted by the barking from a group of six common langurs (*Presbytis entellus*) on some cliffs above the forest level at about 2,740 m, I then saw one member of the group of six being pursued by a leopard. Closer inspection, aided by a telescope, showed this to be a snow leopard with its characteristic pale to mid-grey coat and squat face. Remarkably, after the snow leopard had given up chasing its quarry and perched itself on a nearby rock, the langurs continued to bark from just 10 metres away and on occasion to charge to within 5 metres of the snow leopard. This continued for about half-an-hour after which the snow leopard moved off up a ravine, out of sight, with the langurs following it. Part of the strategy of the snow leopard would seem to be to wait patiently until a langur ventured too close. This is certainly born out by my analysis of leopard scats which showed langur to be the single most important prey item (21% by volume), followed by goral *Nemorhaedus goral* (18%), Himalayan tahr *Hemitagus jemlahicus* (16%) and serow *Nemorhaedus sumatraensis* (11%). Musk deer registered only 2% of the total volume of 28 leopard scats.

Keeping in contact with each other

Given their solitary nature, how do musk deer communicate with each other? Musk deer are essentially sedentary and, based on mapping their tracks in snow, range over areas of 15-32 ha. Males are territorial: their home ranges do not overlap with each other but they do overlap with those of females. Thus, animals may come into contact with each other from time to time by means of visual cues, but the likelihood is reduced by the dense nature of their forest or scrub habitat. Moreover, vocalisation, as a means of long-range communication, is presumed to be incompatible with an anti-predator strategy that relies on remaining inconspicuous.

Scent is the musk deer's key means of communication - droppings, urine and, in the case of males, secretions from the musk and caudal (tail) glands are used as scent marks. There is also the interdigital gland, found in the front feet of the male, but its role in communication remains unknown.

A striking characteristic of musk deer is the way in which it uses specific sites for defaecation. Over 58,400 pellets were counted from one latrine, sheltered from the rain by an overhanging rock, and I estimated that it must have been used at least 169 times over a period of at least seven years. I was amazed by the musk deer's ability to precisely relocate its latrines, reflecting its intimate knowledge of its home range. I once tracked an individual return to and use a latrine that had not been used for ten months. Not only did the latrine lie beneath 40 cm of snow but all the old pellets had long since disintegrated during the intervening monsoon.

By fortnightly monitoring the use of 120 latrines over a 27-month period, I found that their use is seasonal and peaks in December at the height of the mating season (rut). Particularly intriguing is the musk deer's habit of often covering its pellets with leaf litter, soil and other adjacent debris during this season of peak use. This is the driest time of year and I concluded that musk deer deliberately try to keep their pellets moist and, therefore, smelly. There was no evidence from their distribution to suggest that latrines served as boundary markers. In fact measurements of pellet weights suggest that some latrines were used by exclusively by one individual while others were used by several. The extent to which latrines were shared corresponds to the degree of overlap between individuals' ranges. There was evidence of males sharing some latrines with females but not other males. Thus, latrines are communication centres providing information on the identification, whereabouts and perhaps even the reproductive condition of the occupant(s) of a particular home range or set of overlapping home ranges.

Surprisingly, given centuries of use of musk by societies and the farming of musk deer by the Chinese since 1958, very little is understood about the role of musk in scent-marking. The musk gland lies in the male's genital region, opening just a few millimetres anterior to the urethra. It seems that musk is used to scent the male's urine. While tracking males in winter, I noticed that the snow was often stained pink or red from their urine and had a sweet scent when warmed in the hands, whereas the urine of females stained the snow amber and did not smell sweet.

The caudal gland of the male occurs as a thickening at the base of the short (*ca*. 2.5 cm) tail. It exudes a viscous yellow secretion, with an offensive odour, from pores either side of the tail. Typically, male musk deer rub the base of their tail against the stems of bushes or dried herbs and grasses, which results in the tail being naked except at its end. I observed such pasting behaviour on a number of occasions. A more detailed study in Russia has shown that male musk deer mark in this way throughout their home ranges.

While poorly understood, it is clear that musk deer used a variety of scents to communicate over time and space. Over shorter distances, acoustic signals also play a role. For example, I have heard a young musk deer bleating whilst in search of its mother, and when alarmed musk deer often emit a double hiss. Most extraordinary was the trill that I heard one night, reminiscent of peacock quivering its fanned feathers, after seeing a young male suddenly get up from resting and walk quickly out of sight towards the border of his home range. More amazing still was the whiff of musk, distinctive from its sweet scent, which reached me a few minutes later. I concluded that this male was seeing off another older male, known to occupy the adjacent home range.

Finding enough quality food

Being small animals, musk deer have relatively high-energy requirements, and, therefore, are much more selective in their choice of food than other larger Himalayan ungulates. Due to the difficulty of observing animals in daylight, I resorted to identifying plant fragments from their droppings using a microscope. I also analysed the chemical composition of the droppings to ascertain the nutritional quality of the musk deer's diet. Essentially, musk deer are browsers and select easily digestible, nutritious foods that are high in protein and energy (sugars) and low in fibre. Forbs (i.e. herbs excluding grasses) and woody plants constitute the bulk of the diet in summer and winter, respectively. During winter, when food is in short supply, musk deer survive on poorer quality diets. Where available, musk deer may switch to feeding largely on arboreal lichens (*Usnea* spp.), which are low in protein but high in energy. Evergreen foliage, such as *Rhododendron campanulatum*, and arboreal lichens may be the only readily available food plants during winter when the snow may be a metre deep. This was certainly true in parts of the study area and, while tracking musk deer in snow, I often came across rhododendron bushes whose leaves had been eaten - up to 97 leaves per feeding bout.

The availability of food in winter is obviously crucial and, together with hunting, I believe explains why musk deer are no longer found in some parts of their former distribution. Overgrazing by domestic livestock is a widespread problem throughout the Himalaya. It can result in severe depletion of the forest understorey, leaving no shrubs for musk deer to browse during winter when snow covers the ground.

Competing with other ungulates

Another interesting feature of the musk deer is its thick, coarse, wavy hair, which under the electron microscope is like a honeycomb of air-filled cells. The hair has a plastic-like appearance and seemingly is waterproof. No doubt, these modifications provide extremely good insulation from the cold, both in snow and rain conditions. Its ability to live in cold

conditions and move easily through deep, soft snow provides it with a competitive advantage over other ungulates that share its habitat.

Goral, serow and sambar also reside in the Tungnath study area, but there is very little overlap in their use of habitat and in their diet. These ungulates, like musk deer, are essentially solitary, forest-dwellers that are active both during the day and at night. Sambar descend to lower altitudes in winter, leaving only three ungulate species to compete for resources during this critical season. While musk deer and goral are most similar in their use of the habitat in terms of vegetation cover, slope and to a lesser extent aspect (musk deer tend to use more northerly aspects than goral), their diets are the most different. Grasses make up the bulk of the goral's diet in spring and summer. During winter, when herbs are generally snow-covered other than on south-facing cliffs, the species switches to bamboo and to a lesser extent tree (oak) and shrub leaves. The only other ungulates found in the study area were wild boar (*Sus scrofa*) and Himalayan tahr[5]. Evidence of the former was rare, indicating that it was not a significant component of the ungulate community. Tahr inhabited the cliffs along the eastern edge of the study area and, sometimes, small herds emerged to graze the alpine pastures. My previous research in Langtang had shown their diet to comprise mainly grasses and other herbaceous plants.

Of ungulates, men and mountains

India shares with a number of other countries the world's greatest mountain system, the Himalaya, and with them the responsibility to safeguard their natural resources and the cultural heritage and lifestyles of their inhabitants. The challenges are immense, the more so because mountains are particularly difficult environments to manage, being fragile in nature and demanding to work in for even the most intrepid.

Mountains bring out the best and worst in human nature, challenging and inspiring us to ever greater heights of physical feats and depths of personal development, while also providing the battle ground for ethnic and international conflicts. That 23 of today's 27 conflicts are taking place in mountain environments casts a dark shadow on this International Year of the Mountains, but says something about their enormous importance and value to societies around the world.

My own respect and love of mountains matured quickly through my work with tahr on an alp overlooked by the 6,581 m peak of Langtang II. Most of my limited skills in rock climbing were acquired out of necessity during my meagre attempts to keep track of these agile mountain goats. One afternoon I nearly came unstuck. Intent on following a herd of 21 tahr, I followed their route along a narrow ledge. Next I began to traverse a rock face but ran out of handholds. Looking down I realised the enormity of my situation - a sheer drop of perhaps a hundred metres. My arms and legs began to tremble, panic began to take hold me, and I knew that I only had a minute or two before losing all my strength. The way back was probably further than my strength would last - after a moment of prayer to regain my composure, I resolved to venture upwards, clinging somehow with all of my

[5] Himalayan tahr - the ruff is well developed in adult males.

body onto the grain of the rock and aided by the odd grass tussock and wodge of moss. My resolve bore fruit and I vowed never again to be led astray by tahr!

That memory came flooding back ten years later when trying to reach Nanda Devi (7,832 m)[6]. I had admired this peak from afar for three years while studying musk deer. My chance to get a closer peep came in 1987 when I was asked by IUCN-The World Conservation Union to help evaluate the nomination of Nanda Devi National Park for World Heritage status. Not only was I thrilled by the prospect of seeing the magnificent glacial basin, ringed by such other famous peaks as Dunagiri (7,066m), Changabang (6,864 m) and Trisul (7,120 m), but I also hoped to see another Himalayan ungulate for the first time - the so-called blue sheep or bharal (*Pseudois nayaur*). Access to this natural sanctuary is difficult and our route via Dharansi Col at 4,250 m involved a short section where the trail is narrow and hugs the side of the cliffs for 100 m or so. The frozen trail was covered in 20 cm of snow and, unprepared, we had no rope to fix to the pitons left by previous expeditions. Anyone slipping from the trail would have tumbled down the smooth rock face and then dropped a thousand metres towards the Rishi Gorge. My previous sobering experience with tahr got the better of my ambitions and so I slowly turned my back on Nanda Devi. It was a wretched decision but made easier because on this occasion the lives of others were also at stake - others who trusted me.

[6]View from the study area of India's second highest mountain, Nanda Devi, on the extreme left and Trisul to the right of centre.

Selected Bibliography on Mountain Ungulates

(India, Pakistan, Nepal, Bhutan and Tibet Region of China)

S. Agarwal & S. Uniyal

The existing scientific information on mountain ungulates is scanty and scattered. This compilation is the first attempt to collate existing published information on all mountain ungulates species. The bibliography on *Mountain Ungulates* (*Himalayan Region*) currently contains **329** citations that are largely in the English anguage and as popular articles, in books, journal articles and other printed and electronic sources. The bibliography covers almost 165 years (between 1837-2002), however, majority of the citations are of the period 1900 and after. There are a few citations that have been included in the present work that is prior to 1900. The geographical coverage of the database as given in the title is restricted to India, Pakistan, Nepal, Bhutan and the Tibetan plateau (part of China).

The main bibliographical sources consulted for this compilation include the following databases

A. International Database

Wildlife and Ecology Studies Worldwide" CD-ROM (period:1935-2002).

B. WII Library in-house database

- Reprints Database
- Books Database
- WILD (Indexing and Abstracting Database of Indian Wildlife)
- WII publication database
- Mammal Database
- Musk deer database
- Tahr Database (In preparation)

To facilitate easy access to the citations we have provided two indices;

a) the **Author Index** and

b) the **Subject Index**.

We have categorized the bibliography based on the scope of the article and placed them under eight broad subjects heads. Among these Status reports followed by ecology dominate the database (**Table 1**).

Subjects	No. of References
STATUS REPORTS	79
ECOLOGY	78
OTHERS	40
NATURAL HISTORY	39
MORPHOLOGY & TAXONOMY	29
VETERINARY SCIENCE	26
STUDIES IN CAPTIVITY	23
TRADE	15

The trend in the chronological development of literature has been shown in **Table 2**. The number of publications in a year ranged from 0-21 with the year 1991 recording the maximum publications (21).

Time Period	No. of References
1837-1900	11
1901-1960	21
1961-1970	15
1971-1980	49
1981-1990	88
1991-2000	134
2001-2002	6
Undated	5

Over 324 authors have been indexed in this present database and their contribution to increasing our understanding of the Mountain ungulates measured in-terms of number of publications ranged from 1-21, with Dr. Green being the most prolific writer with 21 publications.

For the convenience of the user this bibliography is also available in Database form at the Wildlife Institute of India, Library & Documentation Centre. It is hoped that providing information both in traditional printed form as well as through machine readable database will be very useful and act as a ready reference to both professional and amateur wildlife ecologists and Protected Area Managers, interested in the Himalayan landscape and its diverse and unique array of mountain ungulates.

We would also like to add that this database in not complete. While, all possible efforts have been made to cite the references as accurately as possible, it is probable that some mistakes have remained, largely owing to the compilation of the majority of references from secondary sources. We would be grateful if such mistakes are brought to our notice for correction and continuous upgradation of this database.

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